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Minnesota Retrofit Insulation In Situ Test Program

June 1978

Prepared For

U.S. Department of Energy
Assistant Secretary for Conservation
and Solar Applications
Division of Buildings and Community Systems

Under Contract No. EY-76-C-02-2843

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June 1978

Prepared By
The Minnesota Energy Agency
With the Assistance of
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John Weidt Associates, Inc.,

For
U.S. Department of Energy
Assistant Secretary for Conservation
and Solar Applications
Division of Buildings and Community Systems
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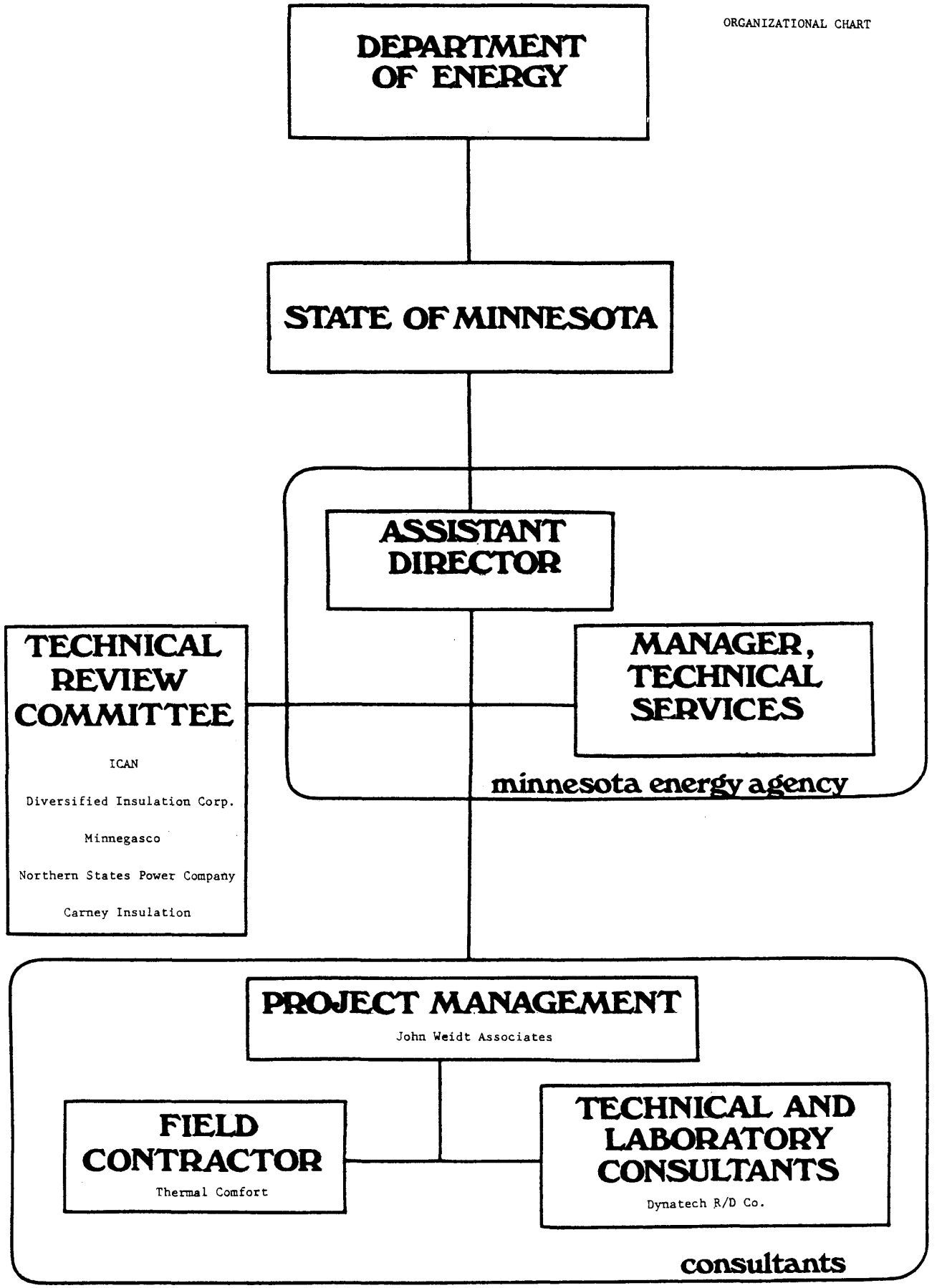


2. INTRODUCTION

It is estimated that there are well over 20 million uninsulated or poorly insulated residential dwellings in the United States. A substantial energy savings can be realized by insulating the walls and ceilings of a significant number of these homes.

Little is known of the performances of insulation materials once installed in walls and ceilings. Insulation is largely unseen, but its insulating properties must remain in effect. Additionally, it must remain compatible with the structural materials and not create conditions deleterious to the integrity of the dwelling or to the health of the occupant. Because substantial energy savings depend upon the quality of these largely unseen insulations, because the health and safety of dwelling occupants may depend upon these materials, and because millions of dollars will be spent by homeowners on these products, the in situ properties of various thermal insulations must be known. This report details the findings of a study of these materials as they exist in the dwelling.

The program consisted of a set of field observations of the insulation and the dwelling and laboratory measurements of properties critical to the insulation's performance. The samples were selected from the Minneapolis and St. Paul, Minnesota metropolitan areas and were obtained during the summer of 1977. Because of the small sample size, the results herein do not possess statistical validity and must be used judiciously. The application of this report should be for planning the course of future programs designed to study insulation in situ.

3. SUMMARY REPORT

3.1 PROJECT DESCRIPTION

3.1.1 Organization

The project studied cellulose, glass fiber, rock/slag fiber and urea formaldehyde installed as retrofit insulation materials in residential walls and ceilings. Local homeowners were requested to volunteer their residences for field testing. Homes were selected for testing according to the type of retrofit insulation, age of retrofit insulation and whether the retrofit was in the wall or ceiling. The total project was comprised of 22 wall and 48 ceiling samples.

3.1.2 Field Work

Samples of retrofit insulation were taken from an area of three to four square feet in the ceiling or wall of the home. Ceiling samples were obtained either directly from open ceilings or by removal of attic floor boards. Wall samples were obtained by removal of the exterior siding of the residence or by cutting open a portion of the interior wall. The sample volume was measured, the sample removed and double-sealed in polyethylene bags, the area inspected, new insulation installed and the area repaired to the satisfaction of the homeowner. Photographs of each phase of the work were made and a work sheet with pertinent information and a sketch of the condition was prepared. The samples were shipped to the laboratory for testing, accompanied by the photographs and worksheets.

3.1.3 Laboratory Work

The test samples were received at the Dynatech Measurements Laboratory and the density determined from the sample weight and from field volume measurements. The moisture content, thermal resistance and relative flammability of each sample was determined. Additionally, the friability and compressive strength of each urea-formaldehyde foam sample was measured.

3.2 FINDINGS AND CONCLUSIONS

3.2.1 Cellulose

Several of the suggested problems with cellulosic loose fill insulation are settling, loss of thermal resistance, moisture build-up within the cellulose causing cellulose deterioration and structural damage, flammability, loss of fire retardancy, fungal growth and corrosion. Project results indicate that settling and moisture build-up are not serious problems. One-third of the samples tested were more flammable than our Class II labelled control and one-fifth could be ignited with a match in air. Age did not affect the properties of the cellulosic loose fill; in fact, the two oldest samples of 11 and 18 years had properties slightly better than the average. No fungal growth was evident. Corrosion was not a studied property.

3.2.2 Urea-Formaldehyde

The notable suggested problems with urea-formaldehyde foam are shrinkage and property degradation with time. Shrinkage occurred with every sample measured, ranging from 2.5 to 9%, averaging 4.5%. This shrinkage did not correlate with any other studied property or with time. Degradation of the foam samples with time did not occur. Density was the most critical property affecting the other properties. The higher the density, the higher the thermal resistence per inch, the lower the friability and the higher the compressive strength.

3.2.3 Mineral Fiber

The relationship between the density and thermal resistance properties of loose fill mineral fiber insulation varied substantially due to differences in fiber diameter, amount of unfiberized mineral and extent of nodular clumping. Accurate prediction of the thermal resistance of loose fill mineral fiber insulations relates to all the above factors and is not solely a factor of density.

3.2.4 Installer and Contract

Concern has been expressed over the possibility of poor workmanship detracting from the effectiveness of the retrofit. Most contractors whose work was examined appeared to be making a conscientious effort to provide workmanlike insulation retrofits. Labels or contracts stating a level of performance were available from 15 homeowners. Two contracts stated levels of performance by "R" factor, the remaining 13 contracts or labels stated performance levels by thickness. Five installations fell below contract statements, while ten installations exceeded performance levels. On the average, the contractors exceeded their stated performance levels by 11 percent. Settling of loose fill material or variations in installation density could account for the majority of the work found to be less than labelled. Although a small percentage of the retrofit insulation jobs observed were judged unsatisfactory, the majority of the contractors involved in this study did not appear to have attempted to misrepresent their products or services to the homeowner.

3.2.5 Condition of Structure and Wiring

There is a degree of apprehension that retrofit insulation of existing homes may have deleterious effects on its structure or wiring. No evidence of deterioration or corrosion in the structural or wiring materials attributable to contact with the retrofit insulations was evident. The materials in this sample did not noticeably affect the structure or wiring of the observed homes.

3.3 RECOMMENDATIONS

3.3.1 Scope of Work

Future projects should be designed to represent a valid sample of retrofit insulation materials, manufacturers and installers. Larger numbers of samples should be taken with greater geographic distribution.

3.3.2 Moisture Content and Vapor Barriers

Observations of wall and ceiling insulations should be made during the winter season to further appraise the accumulation and effects of moisture in attics and walls. Insulation samples should be taken and tested for moisture content. Moisture content should be correlated with the type and amount of venting.

3.3.3 Insulation Installation and Settling

More extensive evaluation of the installation of the retrofit insulations and the potential for settling - particularly in loose fill insulations - should be made. This can be economically accomplished through the use of thermography. Representative areas of voids or settling should then be opened for further observation and testing.

3.3.4 Corrosion

A more rigorous examination of the potential for corrosion of metals in contact with insulation materials should be made. This can be accomplished in the field by placing metal test coupons in wall and attic insulation, allowing them to remain in place for an extended period of time, removing and examining them.

3.3.5 Test Density for Cellulose Loose Fill

The thermal resistance measurements indicated that the cellulosic materials were close to accepted or reference values. However, the practice of cellulosic insulation manufacturers is to have the thermal resistance determined at densities of 2 to 2.5 lbs ft^{-3}. As indicated in this study, the insulation was usually at densities in excess of 3 lbs ft^{-3}. Thus, the thermal resistance values represented for cellulose insulation are, in general, slightly high, not because the values are incorrect for the actual test density, but because the settled densities are higher than the test densities for both wall and ceiling. The test density for a cellulosic loose fill should be the settled density.

3.3.6 Labelling and Contract Performance Statements

Most labels or contract performance statements reviewed during the study were in terms of inches of retrofit insulation. Retrofit insulation contracts would be more meaningful (in terms of energy saving) if related to resistance to thermal transmission instead of inches of thickness.

TABLE 3.1 SUMMARY FINDINGS

Material	Number of Samples	AGE in YEARS		DENSITY $lbs\ ft^{-3}$		THERMAL RESISTANCE (R) per inch $Btu^{-1}h\ ft^2 degF$		% MOISTURE		RELATIVE FLAMMABILITY	% SHRINKAGE	
		range	aver.	range	aver.	range	aver.	range	aver.	Control Equiv.	range	aver.
Cellulose Walls	6	0-2	1.50	3.3 - 3.9	3.65	2.6 - 3.6	3.4	less than 1% to 6%	3%	Average sim. to ClassII labelled material	N/A	N/A
Cellulose Ceilings	15	0 - 18	3.17	1.8 - 3.8	3.15	3.3 - 3.8	3.5	less than 1% to 6%	2%	Average sim. to ClassII labelled material	N/A	N/A
UF Walls	12	0-4	1.85	0.5 - 1.05	0.8	2.5 - 4.5	4.0	1% - 12%	5%	None	2.5% - 9%	4.5%
UF Ceilings	1	1.6	1.6	.05	.05	4.2	4.2	2%	2%	None	4%	4%
Loose fill Glass fiber Walls	3	.5 - 3.4	1.95	1.3 - 4.4	2.55	2.8 - 3.7	3.3	less than 1%	less than 1%	None	N/A	N/A
Loose fill Glass fiber Ceilings	24	.5 - 14	2.63	1.25 - 4.2	2.24	2.35 - 3.85	3.34	less than 1% to 2%	1%	None	N/A	N/A
Glass fiber Batt Ceilings	4	1.2 - 2.5	1.9	0.7 - 2.7	1.48	3.2 - 4.3	3.7	less than 1% to 2%	1%	None	N/A	N/A
Rock/SlagWool Walls	1	2	2	7.0	7.0	3.45	3.45	less than 1%	less than 1%	None	N/A	N/A
Rock/SlagWool Ceilings	4	.17 - 10	3.23	1.5 - 6.7	4.43	2.95 - 3.45	3.28	less than 1% to 4%	2%	None	N/A	N/A

NOTE: N/A = Not applicable

4. MATERIALS STUDIED

Three types of retrofit insulation were studied: (4.1) cellulosic loose fill, (4.2) urea-formaldehyde foam, and (4.3) mineral fiber. For background information, the following descriptions of the manufacture and application are given.

4.1 Cellulosic Loose Fill Insulation

Cellulosic loose fill insulation is manufactured from waste paper materials - primarily newspaper - by macerating until a fibrous fluffy product results. In a continuous process the material is treated with flame retardant chemicals such as boric acid and then is bagged for distribution. The insulation is applied by blowing it pneumatically through a hose either inserted into a hole or opening in a wall or attic or by blowing it to a desired depth in an attic.

4.2 Urea-formaldehyde

Urea-formaldehyde foam is mixed on-site from components such as resin, catalyst, foaming agent and flame retardant at the nozzle using a water carrier and compressed air. The foaming agent and catalyst mixture is generally pumped into a gun where the compressed air mixes with it and mechanically expands it into a foam consisting of small bubbles. The resin is introduced into the gun through a separate line and coats the foam bubbles. The nozzle of the gun is inserted into a hole in the wall and the foam is forced out of the gun and into the wall cavity under pressure. Setting up occurs in seconds although complete curing may require weeks.

4.3 Mineral Fiber Insulation

Mineral fiber insulation can be divided into two groups, glass fiber and rock/slag wool. Glass fiber is made by melting high silica containing materials and spinning glass fibers from the molten material. Rock/slag wool is made by essentially the same process but the raw materials contain a lesser percentage of silica. In general, the raw material for glass fiber is sand while the raw material for rock/slag wool might be slag left over from a steel-making process. The retrofit application of the material is essentially the same as for cellulose except that the pneumatic machinery is more powerful.

5. PROJECT ORGANIZATION AND FIELD WORK

5.1 TEST SUBJECT IDENTIFICATION

Owners of retro-insulated homes were located through utility company records and from call-in volunteers. Northern States Power Company, a local electrical utility involved in financing insulation retrofits of homes in the Minneapolis/St. Paul metropolitan area, generously provided access to their records for this project. The homeowners identified in these records were contacted and requested to participate in the project. Other volunteers were solicited through the use of form letters sent to local companies and public groups. The letter requested that owners of retro-insulated homes contact the Minnesota Energy Agency if they wished to volunteer for this test program.

The project team anticipated that the use of call-in volunteers may produce a biased sample. The team expected that these volunteers wanted their insulation tested because they suspected the quality of their job. A review of the field observations and laboratory test results indicated no evidence of such bias. The quality of the samples from call-in volunteers was distributed in a similar way to that of the homeowners identified through the utility records.

The project did not make use of the records of the various insulation manufacturers, suppliers and contractors located in the Twin Cities area. If a project of larger scope were to be undertaken, these records could facilitate the establishment of a large sample population.

5.2 SUBJECT SELECTION

Homeowners were selected on the basis of the type of retrofit insulation used and whether it was installed in the wall or ceiling. Although the project attempted to select a specific distribution of insulating materials, locations and ages, the actual distribution of samples was governed by the availability of volunteer homeowners. Table 5.1 illustrates the attempted and actual distribution of samples.

Selection of test subjects was complicated by the frequent inability of the homeowner to properly identify the insulation material with which his home had been retrofitted. Table 5.2 illustrates the distribution of volunteers, observations made and samples taken.

5.3 FIELD WORK

Once volunteer homeowners had been identified, the field crew was scheduled to arrive at the site on a date and time convenient to the homeowner. The field inspection team included the project manager, the field contractor and an assistant for wall observations - ceiling observations were made by the contract project manager and an assistant. As the field team arrived at the residence, they identified themselves to the homeowner and proceeded with the work. During a wall evaluation, an area was located where the work could be performed with no damage to the home itself. Where possible, the sample was taken from the north side of the house on the assumption that moisture content may be greater there than on the sides exposed to the summer sun.

In most cases, the wall samples were taken by removing the exterior siding, building paper and sheathing from the homes. Where this could not be done, as in the case of masonry or stucco exteriors, the samples were taken by cutting away part of the interior wall in an inconspicuous and easily repaired area. After removing the test sample, insulation compatible with the retrofit insulation was installed (either glass fiber or pre-formed urea-formaldehyde). The house was then repaired, patched and repainted to the owner's satisfaction.

Ceiling samples were obtained in a location of average depth. In cases where the insulation was below floor boards, the floor boards were removed to expose an adequate sample area. Labels affixed by the insulation contractor were copied for content. Again, the area was reinsulated and repaired to the owners satisfaction.

Photographs were taken to document each stage of the work. A worksheet was prepared containing a sketch of the sample area and the observations and data taken.

5.4 FIELD OBSERVATIONS AND MEASUREMENTS

The following observations and measurements of the wall and ceiling sample areas were made:

Orientation - the exposure of the wall from which the sample was taken (north, east, west, south)

Heating system - the heating system and fuel type (gas, hot water, oil forced air, etc.)

Plan location - the room adjacent to the sample (kitchen, bedroom, bath etc.)

Venting - in attics, the general adequacy of the venting (good, average, minimal, none) related to the HUD minimum property standards; in walls - the mechanical venting of a kitchen, bath or laundry adjacent to the sample area

Framing type - the structural system of the home (stud wall, joist and rafter attic, etc).

Condition of structure - the condition of the general structure and particularly of the structure in the sample area

Condition of wiring - the condition of the conduit, wiring boxes, and exposed wiring related to their exposure to insulation

Original and retrofit insulation and vapor barrier types - the type and location of vapor barriers originally in the wall or ceiling or added during retrofit

Retrofit installation procedures and problems - the method of insulation installation and obvious problems encountered by the contractor during the retrofit.

Odor, vermin, moisture, fungus - examining the sample for signs of odor, moisture, vermin activity or fungus growth

Packing - pressing the sample area to estimate compaction

Friability - crumbling the material by hand to estimate its tendency to pulverize

Measurements - measuring the size of the insulation sample area with a steel tape and probing with a micrometer in several locations to determine depth; measuring the width of shrinkage cracks with a steel tape.

Total shrinkage was calculated as a percent of original specimen.

Dimension:

$$\frac{\text{width of shrinkage cracks x 100}}{\text{cavity width}} = \text{shrinkage \%}$$

Flammability - forming a hand sized ball of the insulation material, dropping a lighted paper match into a depression in the sample and observing any tendency of the material to ignite and sustain combustion

5.5 SAMPLE HANDLING

After making all field observations, the insulation sample was removed, placed in double polyethylene bags and sealed to assure retention of moisture content. The samples were shipped to Dynatech Laboratory in fiberboard shipping barrels.

5.6 HOMEOWNER AND CONTRACTOR INTERVIEW

The homeowner was interviewed to ascertain the age of the home, the contractor who installed the material, the contract terms of the insulation, and the actual date of the retrofit installation.

The installing contractor was contacted to ascertain the manufacturer of the insulation material installed in the home.

5.7 HOMEOWNER FOLLOW-UP

At the termination of the project, the homeowner was provided with the photographs of his test, the on-site worksheet and the lab worksheet generated from his sample, a definition of the worksheet terms and the average results of the study.

TABLE 5.1 SAMPLE DISTRIBUTION

Insulation Material	Location	Number		Age 0-2 Years		Age Over 2 Years	
		Planned	Actual	Planned	Actual	Planned	Actual
Cellulose	Wall	8	6	4	6	4	0
	Ceiling	25	15	13	9	12	6
Urea - Formaldehyde	Wall	8	12	4	9	4	3
	Ceiling	0	1	0	1	0	0
Mineral Fiber	Wall	8	4	4	4*	4	0
	Ceiling	25	32	13	13	12	19
TOTAL		74	70	38	42	36	28

NOTE:
One mineral fiber wall insulation was of unknown age and has been arbitrarily included in the 0-2 year age bracket due to assumptions of age made by the owner.

TABLE 5.2 SUBJECT DISTRIBUTION

Method of Homeowner Identification	Number of Subjects Identified	Number of Field Observations Made	Number of Samples Analyzed
from utility records	77	30	28 (1)
call-in volunteers	40 (3)	44 (3)	42 (2)
TOTAL	117	74	70

NOTES:
1 Two wall samples were opened that could not be tested. In one case, no retrofit insulation had been installed in the cavity; in the other case, existing glass fiber batt precluded the installation of insulation.
2 Two wall samples were opened that were not included in the sample. In one case, there was a very limited amount of retrofit material in the cavity; in the other case, the retrofit had been made with polystyrene chips and was outside the scope of the survey.
3 The difference in the number of subject identified and the number of field observations made may be accounted for by the fact that samples of both wall and ceiling insulations were taken from several homes.

6. LABORATORY PROPERTIES STUDIED

The laboratory properties studied for each material were density, thermal resistance, moisture content and relative flammability. A microscopic examination was made of each material. A measurement of friability and compressive strength were also performed for the urea-formaldehyde foam insulation.

6.1 DENSITY

The density of a material is its mass to volume ratio or stated simply - the weight of a specific volume of the material. For insulations, density is an important property since both the integrity of the insulation fill and the thermal resistance of the insulation are related to the density. An insulation installed at densities within performance guidelines will yield the maximum in thermal efficiency. For loose fill materials applied in walls or attics, densities below acceptable levels will create conditions that can lead to settling and opening of voids within the wall cavity. Knowledge of the settled densities of loose fill materials is a requirement for proper insulation.

6.2 THERMAL RESISTANCE

The thermal resistance of an insulation per unit thickness is a measurement of a material's thermal performance under laboratory conditions. This measurement implies the actual field performance of the insulation. The actual performance of an insulation in the field must be understood in terms of the insulation being part of a system. The system is subject to moisture, settling, and shrinkage. These conditions affect the heat transfer of the system even though the thermal resistance of the insulation may not change.

The thermal resistance of cellulosic loose fill insulation and urea-formaldehyde foams does not vary appreciably from manufacturer to manufacturer. For cellulosic loose fills and urea-formaldehyde foams the measured thermal resistance can be used to evaluate the quality of the insulation by comparing the measured values to typical curves of thermal resistance versus density. Figures 6.1 and 6.2 give typical values for cellulose and urea-formaldehyde. The typical data can be used as a yardstick to indicate the insulation quality or deterioration.

For mineral fiber insulations, the data does not fit a reference curve as do cellulose and urea-formaldehyde because of the variability of mineral fiber insulations. Because the raw material from which the mineral fiber insulations are made varies and because there are differences in manufacturing processes, the physical states of the insulations are dissimilar. For example, there are differences in fiber diameter, amount of unfiberized material and amounts of nodular clumping. These differences affect the thermal resistance and negate the use of a close-fitting reference curve.

6.3 MOISTURE CONTENT

The moisture content of an insulation can indicate problems with vapor transfer. High moisture content within an insulation can adversely affect the thermal performance and can cause deterioration of other insulation properties by creating suitable conditions for settling and for leaching out of chemicals.

6.4 RELATIVE FLAMMABILITY

The relative flammability of a material is a technique for ranking the flammabilities of a material within a group. It does not relate to other techniques for flammability measurement nor does it suggest values of absolute flammability. The values yield comparative data when matched against control samples.

6.5 MICROSCOPIC EXAMINATION

A microscopic examination was performed on each sample of insulation. The purpose of this examination was to determine if there was evidence of microscopic contamination of the insulation such as the presence of fungus. Presence of fungus in the materials, especially cellulose, can indicate that the material properties are deteriorating and that the material may present a health hazard.

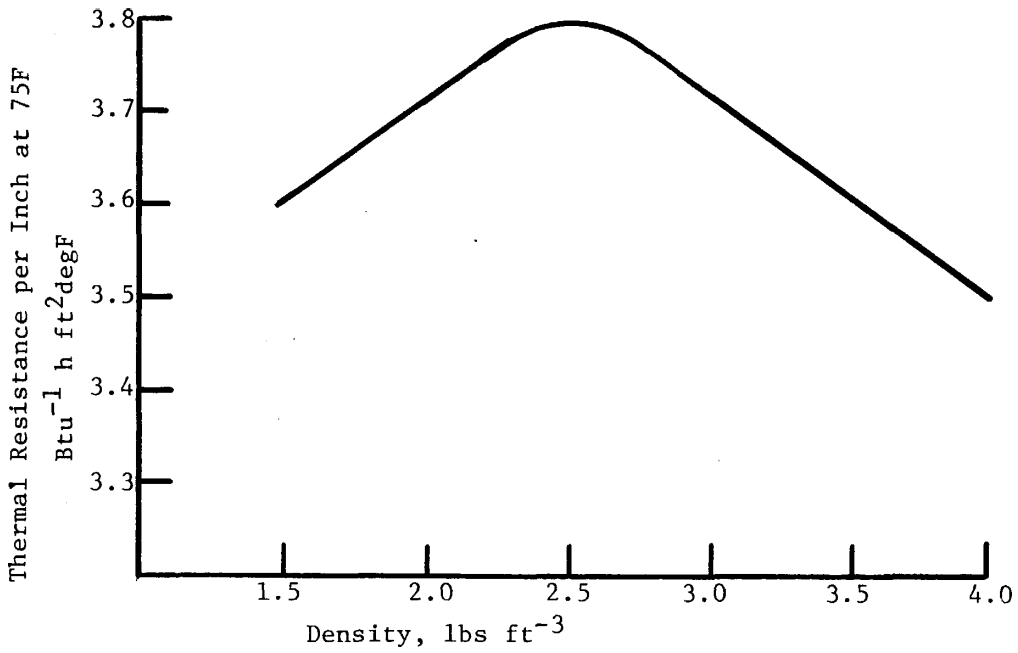
6.6 FRIABILITY

There are reports that urea-formaldehyde foam insulation degrades under conditions of high humidity. The degradation is reported to proceed as a continuous depolymerization and the foam eventually becomes powder. In order to study this degradation, a measurement of friability was performed.

6.7 COMPRESSIVE STRENGTH

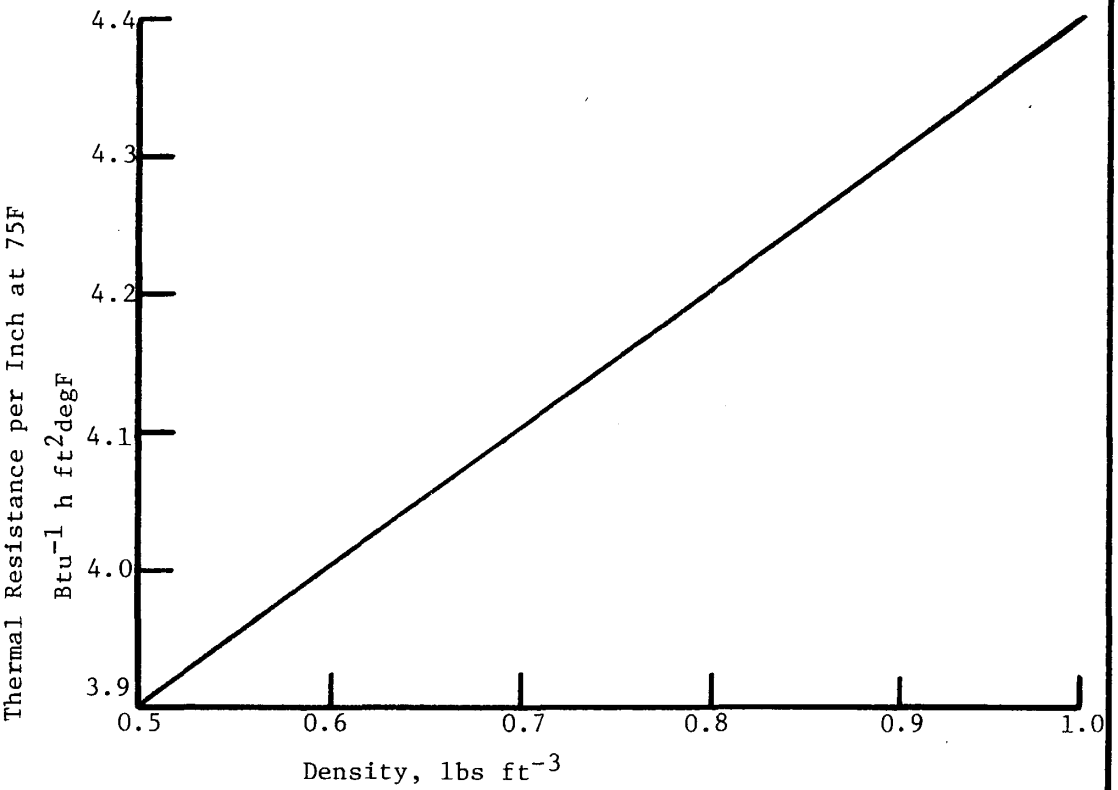
Measurements of the compressive strength of the urea-formaldehyde foam were performed in order to study the structural integrity and discern evidence of degradation.

FIGURE 6.1 REFERENCE DATA FOR CELLULOSIC LOOSE FILL[1]



1 A Dynatech Data Compilation

FIGURE 6.2 REFERENCE DATA FOR UREA-FORMALDEHYDE FOAM[1]



1 A Dynatech Data Compilation

7. LABORATORY EXPERIMENTAL PROCEDURES

7.1 DENSITY

The density of the loose fill materials, both cellulose and mineral fiber, were determined from the volume of the sample measured and recorded during sample removal. A cross-sectional area of either wall or ceiling was marked off and measured. The average thickness of the area was then determined by a depth gauge. The sample was placed in double polyethylene bags and sent to Dynatech. At Dynatech the sample material was weighed and the density calculated from the mass and the volume given by the *in situ* recorded length, width and depth as shown below:

$$D = \frac{m}{(l)(w)(d)}$$

where D = density
m = mass of material submitted in polyethylene bags
l = length of selected cavity section
w = width of cavity
d = average depth of insulation section

The density of the urea-formaldehyde foam was determined by milling a 2 x 12 x 12 inch specimen, when possible, from the supplied sample removed from the wall and packed in double polyethylene bags. The density was determined from:

$$D = \frac{m}{v}$$

where D = density of prepared sample
m = mass of prepared sample
v = volume of prepared sample

7.2 THERMAL RESISTANCE

The thermal resistance of the urea-formaldehyde foam samples was determined with ASTM C518-76, "Steady State Thermal Transmission Properties by Means of the Heat Flow Meter", using a Dynatech Rapid-K apparatus. The upper and lower plates of the instrument were 12 x 12 inch blackened aluminum sinks, containing heaters which were temperature controlled with proportional/reset temperature controllers. Both plates were instrumented with Type T thermocouples. The bottom plate, or cold face, was instrumented with a calibrated heat flux transducer. The temperatures of the upper and lower plates were

controlled at 93 and 57 F respectively. At equilibrium, the thermal resistance per inch of the sample of urea-formaldehyde foam was determined from:

$$R = (q/A)^{-1} \left(\frac{T_h - T_c}{x}\right)$$

where q/A = heat flux as measured by the heat flow transducer
T_h = temperature of upper hot face
T_c = temperature of lower cold face
x = specimen thickness

The thermal resistance of the loose fill insulations, the cellulosic loose fills and the mineral fiber, were determined in accordance with ASTM C518-76, "Steady-State Thermal Transmission Properties by Means of a Heat Flow Meter", using a Dynatech R-Matic heat flow meter apparatus. The upper and lower plates of the instrument were 24 x 24 inch blackened aluminum sinks, containing heaters which were temperature controlled with proportional/reset temperature controllers. Both plates were instrumented with a calibrated integrating heat flow transducer. The temperature of the upper and lower plates were controlled at 50 and 100 F respectively. The samples were placed within insulating containment rings, 3.5 inches thick for wall materials and 6 inches thick for ceiling materials. At equilibrium, the thermal resistance per inch was calculated as above.

7.3 MOISTURE CONTROL

Duplicate 100 gram samples of the loose fill insulation were placed in tared evaporating dishes and weighed. The sample was placed in an air circulating oven at 110 C for 48 hours, removed, placed in a dessicator until cool and reweighed. The percent mass loss assumed to be moisture content was calculated as:

$$\% \text{ moisture content} = \frac{(m_i - m_f)\ (100)}{m_i}$$

where m_i = initial mass
m_f = final weight

Duplicate nominally 3 x 3 x 1 inch specimens of urea-formaldehyde foam insulation were weighed and placed in an air circulating oven at 75 C for 48 hours, removed, placed in a dessicator until cool and reweighed. The percent mass loss assumed to be moisture content was calculated as above.

7.4 RELATIVE FLAMMABILITY

The relative flammability is a measurement of the minimum volume percent of oxygen in an oxygen/nitrogen mixture that will support combustion. The apparatus consisted of a two-piece Pyrex glass column of 5 inch inside diameter and an overall height of 24 inches. The bottom section of the glass column contained 1/4 inch diameter glass beads in a bed 2 inches deep used to mix the inlet gases. The gases used were 99% purity oxygen and nitrogen obtained from regulated gas cylinders. The gas flow rates and volumes were regulated by precision calibrated rotometers. The gases were mixed prior

to entering the column by a T-fitting and 24 inches of tubing. The specimen igniter was a coiled platinum wire heated by a variable voltage supply.

A test consisted of placing the test specimen in stainless metal basket placed on top of the glass beads. The gases were mixed and allowed to flow through the column for a period of ten minutes prior to ignition. Ignition was performed by placing the platinum igniter wire in contact with the insulation. Power was supplied to the wire until ignition of the specimen occurred, usually requiring less than 5 seconds. Ignition of the specimen was designated as the presence of a flame. The igniter was disconnected from the power supply and raised above the specimen.

The criterion for establishing the relative flammability of a test specimen was the minimum percentage of oxygen necessary to support at flame for a period of one minute or until complete combustion of the material occurred. This level was ascertained by beginning the test program at 20% oxygen. The test was performed, the material discarded and another test made at an oxygen level 5% higher. This procedure was followed until the relative flammability was established. A duplicate test was then made and an average of the two test runs taken.

Three control measurements were made for the cellulosic loose fills, a macerated paper with no added chemicals, a sample from cellulosic loose fill labelled Class I and a sample of cellulosic loose fill labelled Class II. The cellulosic test samples were then compared to the controls and a control equivalency recorded. The control samples sustained combustion under the following conditions:

A. Class I labelled material; 60% oxygen environment
B. Class II labelled material; 40% oxygen environment
C. Untreated material: 20% oxygen environment

7.5 MICROSCOPIC EXAMINATION

Several small samples of each insulation specimen were examined for noticeable anomalies (trace of fungus or vermin activity) under a 40 X binocular dissecting scope. Observations by at least two laboratory technicians were carried out on each insulation sample.

7.6 FRIABILITY

Twelve one-inch cubes of each sample of urea-formaldehyde foam were milled and weighed together. These were placed in an oak box containing twenty-four one-inch cubes of oak. The box was rotated at 60 rpm for 2 minutes. At the end of this period, the foam was sieved through a 1/4 inch mesh screen and the foam remaining on the screen was weighed. The friability of the material was measured as percent mass loss calculated as:

$$\% \text{ Friability} = \frac{(m_i - m_f)\ (100)}{m_i}$$

where m_i = initial mass

m_f = mass remaining on screen

7.7 COMPRESSIVE STRENGTH

Three 1 x 3 x 3 inch specimens of each sample of urea-formaldehyde foam were milled and measured. Each specimen was then tested in compression in the one-inch direction at a crosshead speed of 0.05 inches min^{-1} using an Instron TT-C Universal Tester. The compressive strength at 10% deformation was calculated for each specimen and the average for the three determinations reported. The compressive strength was calculated from:

$$\text{Compressive Strength} = \frac{P}{A}$$

where P = load on specimen at 10% deformation
A = cross-sectional area of specimen

8. TABULAR RESULTS

The major results of the field and laboratory work are presented in tabular form in tables 8.1 through 8.18. A discussion of these results will be found in the findings and conclusions section.

TABLE 8.1 CELLULOSIC LOOSE FILL WALLS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Thickness Inches	Vapor Barrier		INSTALLATION PROCEDURES	STRUCTURAL BARRIERS	INSTALLATION PROBLEMS
			Type	Loc.			
2W	none	4.0	none	N/A	3/4" blowhole	plaster droppings in cavity	none
6W	none	3.0	felt	O	2 holes per cavity	convection barrier [1]	none
8W	none	3.3	shin-gles	O	1 hole per cavity	none	door framing not filled
15W	none	3.2	foil	O	unknown	none	none
23W	none	2.0	none	N/A	2 holes per cavity	none	frame and corner not filled
27W	none	2.2	none	N/A	unknown	none	none

NOTES:

1 A convection barrier is a device installed to reduce convection currents within a wall cavity. It is usually made of tar paper and stapled to the sides of the studs within the cavity, dividing it into two shallower segments of approximately 1 3/4" each.

Vapor Barrier Location

O = outside of cavity
I = inhabited side of cavity
M = middle of cavity
N/A = not applicable

TABLE 8.2 CELLULOSE LOOSE FILL WALLS LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 degF			Moisture Content %	Relative Flammability Control Equivalent
			Measured	Reference[1]	% Deviation		
2W	2	3.35	3.5	3.65	-4	6	Less than Class II labelled control material
6W	1.75	3.30	3.6	3.65	-1	< 1	Similar to Class II labelled control material
8W	1.00	3.75	3.6	3.55	+1	< 1	Similar to Class I labelled control material
15W	2.00	3.90	3.15	3.55	-11	4	Similar to Class II labelled control material
23W	1.33	3.80	3.25	3.55	-8	2	Less than Class II labelled control material
27W	1	3.8	3.35	3.55	-6	2	Similar to Class II labelled control material
Average	1.5	3.65	3.4	3.6	-5	3	Similar to Class II labelled control material

NOTES:

1 Expected thermal resistance of this material at a specific density taken from the Dynatech compilation and presented as a curve in figure 6.1

TABLE 8.3 CELLULOSE CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting[1]	Vapor Barrier	
				Type	Location
1C	none	4.6" cellulose	minimal	none	not applicable
11C	none	5.3" cellulose	none	none	not applicable
12C	mineral fiber loose fill	7.5" cellulose 1.0" original	minimal	none	not applicable
13C	mineral fiber loose fill	4.5" total	none	none	not applicable
17C	wood shavings	4.5" cellulose	none	none	not applicable
21C	mineral fiber batt	10.1" cellulose 3.5" original	minimal	foil	between insulation layers
23C	none	6.0" cellulose	minimal	none	not applicable
26C	none	4.5" cellulose	none	none	not applicable
27C	mineral fiber batt	5.8" cellulose 3.8" original	minimal	none	not applicable
32C	mineral fiber batt	3.0" cellulose 2.0" original	minimal	paper	between insulation layers
33C	wood fiber batt	3.5" cellulose 2.0" original	average	paper	inhabited side of cavity

(Table 8.3 continued on Page 22)

TABLE 8.3 (cont.) CELLULOSE CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting [1]	Vapor Barrier	
				Type	Location
34C	mineral fiber loose fill	5.3" cellulose 3.0" original	average	none	not applicable
44C	mineral fiber batt	4.5" cellulose 3.0" original	minimal	foil	inhabited side of cavity
49C	mineral fiber loose fill	11.5" cellulose 1.0" original	minimal	poly	inhabited side of cavity
55C	none	5.3" cellulose	minimal	none	not applicable

NOTES:

1 Attic ventilation was observed by the field crew and evaluated in relation to HUD Minimum Property Standards for 1 & 2 Family Dwellings 4900.1, which calls for a free ventilating area of 1/150 to 1/300 of the horizontal projection of the insulated ceiling area. Where no intentional or incidental (i.e. cracks in the soffit or roof boards) ventilation was obvious, the venting was considered "none". Where some evidence of ventilation was seen but was estimated at less than 1/300th of the insulated ceiling area, the venting was termed "minimal". When the ventilated area was estimated at between 1/300th and 1/150th of the insulated ceiling area, the ventilation was considered "average". When the ventilated area was estimated at 1/150th of the insulated ceiling or over, the ventilation was considered "good". Determination of the level of attic ventilation was made by visual estimate, since vent location and attic conditions made it impractical to take physical measurements in most cases.

TABLE 8.4 CELLULOSE LOOSE FILL CEILINGS LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F			Moisture Content %	Relative Flammability Control Equivalent
			Measured	Reference	% Deviation		
1C	.50	1.95	3.75	3.75	0%	less than 1%	Less than Class II labelled control material
11C	3.00	5.00	3.35	3.30	+2%	less than 1%	Similar to Class I labelled control material
12C	.75	3.50	3.50	3.60	-3%	less than 1%	Similar to Class I labelled control material
13C	1.50	3.50	3.80	3.60	+6%	less than 1%	Similar to Class II labelled control material
17C	18.00	3.30	3.45	3.65	-5%	6%	Similar to Class II labelled control material
21C	2.00	1.80	3.40	3.75	-9%	5%	Similar to Class II labelled control material
23C	1.75	2.20	3.50	3.80	-8%	2%	Similar to Class II labelled control material
26C	1.50	2.60	3.45	3.80	-9%	2%	Similar to Class I labelled control material

(Table 8.4 continued on Page 24)

TABLE 8.4 (cont.) CELLULOSE LOOSE FILL CEILINGS LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F			Moisture Content %	Relative Flammability Control Equivalent
			Measured	Reference	% Deviation		
27C	1.00	3.80	3.35	3.55	-3%	2%	Similar to Class II labelled control material
32C	.17	3.50	3.45	3.6	-4%	2%	Similar to untreated control material - Burns in air
33C	2.5	3.1	3.7	3.7	0%	2%	Less than Class II labelled control material
34C	11.0	3.6	3.6	3.6	0%	2%	Similar to Class II labelled control material
44C	3.33	2.4	3.35	3.8	-13%	less than 1%	Similar to Class II labelled control material
49C	.17	3.5	3.5	3.6	-3%	5%	Similar to untreated control material- Burns in air
55C	2.50	3.8	3.25	3.55	-8%	less than 1%	Similar to Class II labelled control material
Average	2.50	3.15	3.5	3.65	-4%	2%	Similar to Class II labelled control material

TABLE 8.5 UREA-FORMALDEHYDE WALLS - FIELD OBSERVATIONS

Sample Number	Origianl Insulation	Thickness Inches	Vapor Barrier		INSTALLATION PROCEDURES	STRUCTURAL BARRIERS	INSTALLATION PROBLEMS
			Type	Loc.			
1W	MFB	3.5	paper	M	unknown	none	none
4W	none	0.0	none	N/A	two holes per cavity	convection barrier	see note 1.
7W	none	3.3	foil	I	1½" hole midway up wall single hole/cavity	none	foam did not fill all cavities
10W	none	3.7	none	N/A	multiple holes per cavity	odd framing	foam did not fill all cavities
11W	none	1.9	none	N/A	one hole per cavity	lath and plaster interior - backplaster	none
13W	MFL	3.3	none	N/A	two holes per cavity per story	convection barrier material in cavity	none
17W	W	3.6	none	N/A	two holes per cavity per story	cavity filled with wood shavings	foam did not fill cavity

(Table 8.5 continued on Page 26)

TABLE 8.5 (cont.) UREA FORMALDEHYDE WALLS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Thickness Inches	Vapor Barrier		INSTALLATION PROCEDURES	STRUCTURAL BARRIERS	INSTALLATION PROBLEMS
			Type	Loc.			
24W	none	3.4	none	N/A	two holes per cavity per story	backplaster	none
25W	none	3.0	none	N/A	unknown	none	material appeared to set up layers
26W	none	2.8	none	N/A	unknown	backplaster	none
38W	none	3.5	none	N/A	two holes per cavity	none	none
40W	none	3.4	none	N/A	two holes per cavity	none	none
41W	none	3.3	none	N/A	one hole top of cavity	none	none

NOTES:

1. Foam not in all cavities, thin film of insulation in some cavities.

Original Insulation Types

MFL - mineral fiber loose-fill
MFB - mineral fiber batt
WFB - wood fiber batt
V - vermiculite
C - cork
W - wood shavings

Vapor Barrier Location

O = outside of cavity
I = inhabited side of cavity
M = middle of cavity
N/A = not applicable

TABLE 8.6 UREA-FORMALDEHYDE WALLS LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F			Moisture Content %	Friability % Mass Loss	Compressive Strength at 10% Deflection lbs in^{-2}	Shrinkage %
			Measured	Reference	% Deviation				
1W	.5	0.9	4.3	4.3	0	8	19	1.7	4
7W	2.0	0.65	3.8	4.05	-6	2	19	1.0	(Note 1)
10W	1.17	1.05	4.2	4.45	-6	2	10	2.0	4
11W	3.0	0.6	4.0	4.0	0	1	59	(Note 3)	4
13W	1.5	0.9	3.45	4.3	-20	8	6	1.9	(Note 2)
17W	4.0	1.0	4.15	4.4	-6	5	37	2.6	(Note 1)
24W	1.0	0.5	3.9	3.9	0	4	24	0.2	4

(Table 8.6 continued on Page 28)

TABLE 8.6 (cont) UREA-FORMALDEHYDE WALLS LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F			Moisture Content %	Friability % Mass Loss	Compressive Strength at 10% Deflection lbs in^{-2}	Shrinkage %
			Measured	Reference	% Deviation				
25W	2.5	0.65	3.75	4.05	-7	6	8	0.8	7
26W	1.5	0.75	3.85	4.15	-7	2	20	0.5	9
38W	.5	0.95	4.35	4.35	0	5	19	1.9	3
40W	1.17	0.85	3.85	4.25	-9	6	28	1.6	3
41W	.5	0.75	4.45	4.15	+7	8	25	2.2	2.5
Average	1.6	0.8	4.0	4.2	4.5	4.75	23	1.4	4.5

NOTES:

1 Incomplete fill of the cavity at the sample point made it impossible to make lateral shrinkage measurements
2 The configuration of a convection barrier in the cavity made it impossible to measure the horizontal shrinkage of the material
3 Material of insufficient dimension to perform test

TABLE 8.7 UREA-FORMALDEHYDE CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting[1]	Vapor Barrier	
				Type	Location
10C	none	3.7" retrofit	none	none	not applicable

1 Attic ventilation was observed by the field crew and evaluated in relation to HUD Minimum Property Standards for 1 & 2 Family Dwellings 4900.1, which calls for a free ventilating area of 1/150 to 1/300 of the horizontal projection of the insulated ceiling area. Where no intentional or incidental (i.e. cracks in the soffit or roof boards) ventilation was obvious, the venting was considered "none". Where some evidence of ventilation was seen but was estimated at less than 1/300th of the insulated ceiling area, the venting was termed "minimal". When the ventilated area was estimated at between 1/300th and 1/150th of the insulated ceiling area, the ventilation was considered "average". When the ventilated area was estimated at 1/150th of the insulated ceiling or over, the ventilation was considered "good". Determination of the level of attic ventilation was made by visual estimate, since vent location and attic conditions made it impractical to take physical measurements in most cases.

TABLE 8.8 UREA-FORMALDEHYDE CEILING LABORATORY PROPERTIES

Sample Number	Age/Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F			Moisture Content %	Friability % Mass Loss	Compressive Strength at 10% Deflection lbs in^{-2}	Shrinkage %
			Measured	Reference	% Deviation				
10C	1.17	0.65	4.2	4.05	+4	2	58	0.6	4

TABLE 8.9 LOOSE FILL GLASS FIBER WALLS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Thickness Inches	Vapor Barrier		INSTALLATION PROCEDURES	STRUCTURAL BARRIERS	INSTALLATION PROBLEMS
			Type	Loc.			
3W	WFB	3.0	felt	O	unknown	none	did not fill corner
12W	none	1.5	none	N/A	unknown	heavy backplaster, shallow void	none
16Wa	none	0	none	N/A	unknown	complicated framing	no insulation in cavity
16Wb	none	3.8	poly	O	unknown	firestop	loose packing
18W	MFB	0	none	N/A	two holes per cavity	batt insulation in cavity	no new insulation installed

NOTES:

Original Insulation Types

MFL - mineral fiber loose fill
MFB - mineral fiber batt
WFB - wood fiber batt
V - vermiculite
C - cork
W - wood shavings

Vapor Barrier Location

O = outside of cavity
I = inhabited side of cavity
M = middle of cavity
N/A = not applicable

TABLE 8.10 GLASS FIBER LOOSE FILL WALLS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F	Moisture Content %
3W	-	4.4	3.7	1
12W	3.4	1.95	3.4	1
16Wb	.5	1.3	2.8	1
Average	1.0	3.7	3.3	1

TABLE 8.11 LOOSE FILL GLASS FIBER CEILINGS FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting	Vapor Barrier	
				Type	Location
9C	mineral fiber batt	5.4" retrofit 1.9" original	minimal	none	not applicable
16C	mineral fiber batt	3.3" retrofit 1.5" original	minimal	paper	inhabited side of cavity
18C	mineral fiber batt	7.5" retrofit	average	paper	inhabited side of cavity
19C	mineral fiber loose fill	6.5" retrofit 2.5" original	good	paper	inhabited side of cavity
20C	mineral fiber loose fill	7.5" retrofit 3.5" original	minimal	paper	inhabited side of cavity
22C	none	7.4" retrofit	average	poly	inhabited side of cavity
29C	none	7.3" retrofit	average	none	not applicable
30C	mineral fiber loose fill	5.8" retrofit 3.0" original	average	paper	inhabited side of cavity
31C	mineral fiber loose & batt	5.3" retrofit 5.3" original	good	paper	inhabited side of cavity
35C	mineral fiber loose fill	7.8" retrofit 3.5" original	minimal	paper	inhabited side of cavity
36C	mineral fiber batt	6.5" retrofit 5.5" original	minimal	poly	inhabited side of cavity
37C	wood fiber loose fill	10.0" retrofit 2.5" original	good	paper	inhabited side of cavity
38C	vermiculite	13.3" retrofit 2.8" original	good	none	not applicable
39C	mineral fiber loose fill	10.0" retrofit 2.0" original	good	paper	inhabited side of cavity
43C	mineral fiber loose fill	9.3" retrofit 1.0" original	good	paper	inhabited side of cavity

(Table 8.11 continued on Page 33)

TABLE 8.11 (cont.) LOOSE FILL GLASS FIBER CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting	Vapor Barrier	
				Type	Location
45C	mineral fiber batt	4.3" retrofit 2.0" original	minimal	paper	inhabited side of cavity
46C	wood fiber batt	8.5" retrofit 2.5" original	average	paper	inhabited side of cavity
47C	wood fiber batt	6.5" retrofit 2.0" original	average	paper	inhabited side of cavity
48C	mineral fiber batt	6.8" retrofit 3.0" original	minimal	paper	inhabited side of cavity
50C	mineral fiber loose fill	5.5" retrofit 6.5" original	good	poly	inhabited side of cavity
51C	mineral fiber loose fill	6.5" retrofit 3.5" original	average	paper	inhabited side of cavity
52C	mineral fiber loose fill	8.8" overall	good	paper	inhabited side of cavity
53C	mineral fiber loose fill	5.5" retrofit 5.0" original	good	foil	inhabited side of cavity
54C	mineral fiber loose fill	8.0" retrofit 3.5" original	average	paper	inhabited side of cavity

NOTES:

1 Attic ventilation was observed by the field crew and evaluated in relation to HUD Minimum Property Standards for 1 & 2 Family Dwellings 4900.1, which calls for a free ventilating area of 1/150 to 1/300 of the horizontal projection of the insulated ceiling area. Where no intentional or incidental (i.e. cracks in the soffit or roof boards) ventilation was obvious, the venting was considered "none". Where some evidence of ventilation was seen but was estimated at less than 1/300th of the insulated ceiling area, the venting was termed "minimal". When the ventilated area was estimated at between 1/300th and 1/150th of the insulated ceiling area, the ventilation was considered "average". When the ventilated area was estimated at 1/150th of the insulated ceiling or over, the ventilation was considered "good". Determination of the level of attic ventilation was made by visual estimate, since vent location and attic conditions made it impractical to take physical measurements in most cases.

TABLE 8.12 LOOSE FILL GLASS FIBER CEILINGS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs $ft.^{-3}$	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F	Moisture Content %
9C	2.0	2.2	3.85	1
16C	.5	2.2	3.85	1
18C	.75	1.3	3.25	1
19C	3.0	2.4	3.05	2
20C	3.0	2.1	3.05	1
22C	14	3.4	3.05	1
29C	1.0	1.25	2.35	1
30C	2	1.5	3.05	1
31C	1.5	1.7	3.35	1
35C	2.0	2.35	3.0	1
36C	1.0	4.2	3.7	1
37C	2.0	1.4	2.95	1
38C	.5	2.9	3.75	1
39C	2.0	2.05	3.45	1
43C	3.5	1.7	3.25	1
45C	3.17	2.4	3.7	2
46C	2.0	1.4	3.25	2

(Table 8.12 continued on Page 35)

Table 8.12 (cont.) LOOSE FILL GLASS FIBER CEILINGS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 degF	Moisture Content %
47C	3.0	2.3	3.45	1
48C	3.0	1.6	3.15	1
50C	3.0	2.95	3.7	1
51C	1.0	2.15	3.45	2
52C	3.0	2.5	3.7	1
53C	3.25	3.55	3.45	2
54C	3.0	2.35	3.35	2
Average	2.63	2.24	3.34	1

TABLE 8.13 ROCK/SLAG WOOL WALLS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Thickness Inches	Vapor Barrier		INSTALLATION PROCEDURES	STRUCTURAL BARRIERS	INSTALLATION PROBLEMS
			Type	Loc.			
9W	MFB	2.7	paper	I	unknown	none	did not fill at window

NOTES:

Original Insulation Types

MFL - mineral fiber loose fill
MFB - mineral fiber batt
WFB - wood fiber batt
V - vermiculite
C - cork
W - wood shavings

Vapor Barrier Location

O = outside of cavity
I = inhabited side of cavity
M = middle of cavity
N/A = not applicable

TABLE 8.14 ROCK/SLAG WOOL LOOSE FILL WALLS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs ft^{-3}	Thermal Resistance Per Inch Btu^{-1} h ft^2 deg F	Moisture Content %
9W	2	7.0	3.45	1

TABLE 8.15 ROCK/SLAG WOOL CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting[1]	Vapor Barrier	
				Type	Location
8C	none	5.0" retrofit	average	none	not applicable
14C	none	4.5" total	average	none	not applicable
15Ca	wood fiber batt	3.7" total	average	paper	inhabited side of cavity
42C	wood fiber batt	9.0" retrofit 7.3" original	good	poly	inhabited side of cavity

NOTES:

1 Attic ventilation was observed by the field crew and evaluated in relation to HUD Minimum Property Standards for 1 & 2 Family Dwellings 4900.1, which calls for a free ventilating area of 1/150 to 1/300 of the horizontal projection of the insulated ceiling area. Where no intentional or incidental (i.e. cracks in the soffit or roof boards) ventilation was obvious, the venting was considered "none". Where some evidence of ventilation was seen but was estimated at less than 1/300th of the insulated ceiling area, the venting was termed "minimal". When the ventilated area was estimated at between 1/300th and 1/150th of the insulated ceiling area, the ventilation was considered "average". When the ventilated area was estimated at 1/150th of the insulated ceiling or over, the ventilation was considered "good". Determination of the level of attic ventilation was made by visual estimate, since vent location and attic conditions made it impractical to take physical measurements in most cases.

TABLE 8.16 ROCK/SLAG WOOL LOOSE FILL CEILINGS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs ft.$^{-3}$	Thermal Resistance Per Inch Btu^{-1} h ft^{2} deg F	Moisture Content %
8C	unknown	6.7	3.35	1
14C	10	5.0	2.95	2
15Ca	2.75	4.5	3.35	4
42C	.17	1.5	3.45	1
Average	3.23	4.43	3.28	2

TABLE 8.17 GLASS FIBER BATT CEILINGS - FIELD OBSERVATIONS

Sample Number	Original Insulation	Insulation Thickness	Attic Venting[1]	Vapor Barrier	
				Type	Location
15Cb	mineral fiber batt	7.5" retrofit	average	poly	inhabited side of cavity
24C	cork/mineral fiber loose	8.0" retrofit 4.0" original	minimal	none	not applicable
25C	none	6.0" retrofit	minimal	none	not applicable
28C	wood fiber batt	3.5" retrofit 2.0" original	good	none	not applicable

NOTES:

1 Attic ventilation was observed by the field crew and evaluated in relation to HUD Minimum Property Standards for 1 & 2 Family Dwellings 4900.1, which calls for a free ventilating area of 1/150 to 1/300 of the horizontal projection of the insulated ceiling area. Where no intentional or incidental (i.e. cracks in the soffit or roof boards) ventilation was obvious, the venting was considered "none". Where some evidence of ventilation was seen but was estimated at less than 1/300th of the insulated ceiling area, the venting was termed "minimal". When the ventilated area was estimated at between 1/300th and 1/150th of the insulated ceiling area, the ventilation was considered "average". When the ventilated area was estimated at 1/150th of the insulated ceiling or over, the ventilation was considered "good". Determination of the level of attic ventilation was made by visual estimate, since vent location and attic conditions made it impractical to take physical measurements in most cases.

TABLE 8.18 GLASS FIBER BATT CEILINGS LABORATORY PROPERTIES

Sample Number	Age Years	Density lbs $ft.^{-3}$	Thermal Resistance Per Inch Btu^{-1} h ft^{2} deg F	Moisture Content %
15Cb	2	.65	3.15	2
24C	1.2	2.65	4.25	1
25C	2.5	.6	3.3	1
28C	2.0	2.0	4.1	1
Average	1.93	1.48	3.7	1

9. FINDINGS AND CONCLUSIONS

9.1 CORRELATIONS

9.1.1 General Findings

The results of the field observations made and the laboratory properties studied were analyzed for possible cross-correlations. Where mathematical correlations could be drawn (such as between shrinkage of urea-formaldehyde foam and age of retrofit), a calculation of correlation coefficients was determined using a Hewett Packard Calculator and curve-fitting programs 03-01.

Where no mathematical correlations could be drawn (such as between original insulation type and retrofit problems), the results were tabulated and examined forapparent pattern. Table 9.1 illustrates the various interrelationships between the elements of the field and laboratory work. An X marking the intersection of two elements indicates that a relationship between those elements was investigated.

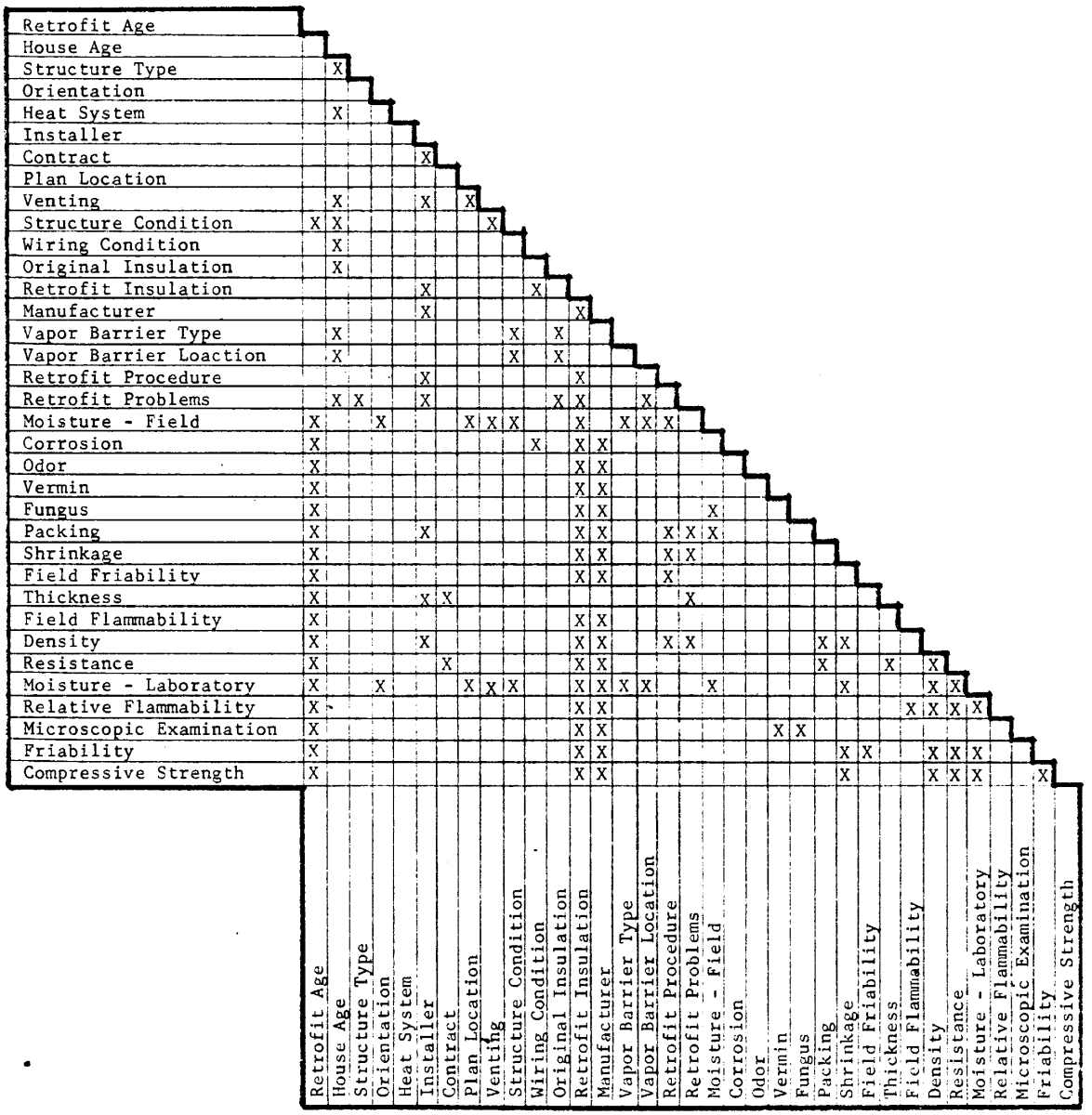
9.1.2 General Conclusions

No relevant correlations between the following properties and any other property were evident:

Orientation
Heating System
Structure Type
Plan Location
Retrofit Procedures
Age of Home
Original Insulation

All other conclusions regarding correlations will be found in following sections.

Variable Correlation Chart 9.1



9.2 CELLULOSIC LOOSE FILL INSULATION

9.2.1 Findings - Wall Applied Cellulosic Loose Fill

Six samples of wall applied cellulosic loose fill were taken with an age spread of from 1 to 2 years with an average age of 1.5 years. The density spread was from 3.3 to 3.9 lbs ft^{-3} with an average density of 3.65. The thermal resistances per inch varied from 3.15 to 3.6 Btu^{-1} h ft^2 degF with an average of 3.4. Based on a reference curve of thermal resistance versus density, the average of the values was within 5% of the expected value. The moisture contents varied from less than 1% to 6% with an average of 3%. One material was similar to the Class I labelled control and three to the Class II labelled control. The other samples were more flammable than the Class II labelled control. The microscopic examination showed no presence of fungus. The results are shown in Table 8.2.

9.2.2 Findings - Ceiling Applied Cellulosic Loose Fill

Fifteen samples of ceiling applied cellulosic loose fill were taken with an age spread of from 2 months to 18 years with an average age of 3.3 years. The density spread was from 1.8 to 5 lbs ft^{-3} with an average density of 3.15. The thermal resistance per inch varied from 3.25 to 3.8 Btu^{-1} h ft^2 degF with an average of 3.5. Based on an accepted curve of thermal resistance versus density, the average of the values was within 4% of the expected value. The moisture contents varied from less than 1% to 6% with an average of 2%. Three of the samples were similar to the Class I labelled control and seven to the Class II labelled control. One sample exhibited flame retardant properties and four samples had little if any flame retardant properties. Two of these samples burned completely while the other two samples exhibited a lingering flame but self-extinguished when ignited by a match in the field. The microscopic examination showed no presence of fungus. The results are summarized in Table 8.4.

9.2.3 Conclusions

The average density of the cellulosic loose fill insulations was greater than the coverage densities given by the cellulose manufacturers on the bags. This occurred because of settling or because the cellulose was applied at greater densities.

The thermal resistance values averaged 4% less than the reference values. The thermal resistance of the cellulosic loose fills did not deteriorate with time; the oldest cellulose samples possessed similar thermal resistance characteristics to the average of all cellulose samples.

The moisture content of cellulosic loose fills averaged 2%, which means that the cellulosic was very dry. Either this is typical of cellulose or the material dried substantially during the spring prior to sampling. Sampling during the winter months will yield more information about moisture conditions.

One-third of the cellulose samples tested were more flammable than the Class II labelled control. About one-fifth of the cellulose samples could be ignited with a match and would continue burning. This percentage of flammable cellulose samples should be a concern.

No fungi were detected growing within the cellulose.

No deterioration with age occured with any measured property.

9.3 UREA-FORMALDEHYDE FOAM

9.3.1 Findings

Twelve samples of wall applied urea-formaldehyde foam were removed with an age spread of from 6 months to 4 years, with an average of 1.6 years. Since urea-formaldehyde foam is not typically applied to ceilings, only one ceiling sample was taken and the results considered together with the wall samples.

The density spread was from 0.5 to 1.05 lbs ft^{-3} with an average 0.8 lbs ft^3. The average of the thermal resistance values were within 4% of the reference values based on the data in Figure 6.2 and varied from 3.45 to 4.45 $Btu^{-1}h\ ft^2$ deg F. The average thermal resistance was 4.0 $Btu^{-1}h\ ft^2$ deg F. As the density increased, the moisture content and compressive strength increased. And as the density increased, the friability decreased. The moisture content varied from 1 to 12% and correlated positively with density and compressive strength and, negatively with friability. The friability varied from 6 to 59% and correlated negatively with moisture content and density. The friability of the ceiling sample was one of the highest observed at 58% mass loss. The compressive strength varied from 0.2 to 2.6 lbs ft^{-3} and correlated positively with density and moisture content. The relative flammability of all urea-formaldehyde foam samples was non-burning. A microscopic examination of the material showed no anomalies. The results are given in Tables 8.6 & 8.8.

9.3.2 Conclusions

The density of the urea-formaldehyde foam insulations averaged 0.8 lbs ft^{-3}. One sample was 0.5 lbs ft^{-3}; the others were 0.6 and greater. The properties of the foam correlated with density; the higher the density, the higher the thermal resistance and compressive strength, the lower the friability.

The thermal resistance values average 4% less than the reference values. The thermal resistance of the urea-formaldehyde foams did not deteriorate with age.

All foam samples exhibited shrinkage. The shrinkage did not correlate with time; that is, the older samples did not have the highest shrinkage. The shrinkage exhibited varying cross-sectional shape. Foam installed during the winter months showed greater contraction at the outside cold surface than at the inside warm suface, while summer installations appeared to contract equally between inside and outside surfaces. The total amount of shrinkage did not relate to season of installation.

The friability and compressive strength of the foam samples correlated with density but not with age. The foam samples did not deteriorate with time.

9.4 MINERAL FIBER INSULATIONS

9.4.1 Wall Applied Mineral Fiber Insulations

Four samples of mineral fiber insulation were removed with an age spread of 6 months to 2 years with one unknown. The densities varied from 1.3 to 7.0 lbs ft^{-3} and the thermal resistances, from 2.8 to 3.7 $Btu^{-1}h\ ft^2$ deg F. The moisture contents were less than 1%. The relative flammability of all mineral fiber insulations was non-burning, exclusive of paper backings. A microscopic examination showed no anomalies. The results are given in Tables 8.10 and 8.14.

9.4.2 Ceiling Applied Mineral Fiber Insulations

Thirty-two samples of ceiling applied mineral fiber insulations were removed, twenty-eight were glass fiber and four were rock/slag wool. Four of the glass fiber were batts. The ages varied from 2 months to 14 years with one unknown and an average age of 2.7 years. The densities varied from 0.65 to 6.7 lbs ft^{-3} and the thermal resistance from 2.35 to 4.25 Btu^{-1} h ft2 deg F. The average density was 2.4 lbs ft^{-3} and the average thermal resistance was 3.4 Btu^{-1} h ft^2 deg F. The moisture contents were less than 1%. The relative flammability of all mineral fiber insulations was non-burning, exclusive of paper backings. A microscopic examination showed no anomalies. The results are shown in Tables 8.12 and 8.16 and 8.18.

9.4.3 Conclusions

The relation between the density and thermal resistance of the mineral fiber insulations varied substantially. No reference curve fit could be made because of the variability.

The moisture content was negligible.

9.5 ATTIC VENTILATION

9.5.1 Findings

HUD Minimum Property Standards require one square foot of attic ventilation for each 150 square feet of ceiling space when no ceiling vapor barrier is installed, and one square foot per 300 square feet of ceiling space when a one perm vapor barrier is installed on the warm side of the ceiling. Further, this ventilation should be divided equally between the upper portion of the space and the eave or cornice vents. Generally, the venting installed in the test attics was less than as recommended. Few signs of moisture accumulation or structural deterioration due to moisture were observed.

A visual inspection of the free area of attic vents related to the total area of insulated ceiling indicated that approximately 1/3 of the mineral fiber retrofitted attics and nearly all of the cellulose retrofitted attics were ventilated below the recommendations of the HUD Minimum Property Standards. A careful inspection of the sheathing nail tips for corrosion and roof boards for staining revealed little evidence of past moisture accumulation that might be attributable to excessive winter moisture build-up in these minimally ventilated attics. One owner reported moisture accumulation during one winter season which had since been corrected by the addition of roof vents. No signs of staining were observed in that attic. Stop boards in the eaves of another attic showed signs of deterioration due to the improper installation of roof rafter insulation. This insulation had been removed.

9.5.2 Conclusions

The observations of reinsulated attics were made during the summer months, and actual moisture accumulation was not present. The effects of winter moisture accumulation evidenced by staining and rusting may not be evidenced for several winter seasons, especially where the dewpoint is reached within the insulation. Additionally, minimal ventilation frequently occurred in older homes with presumably higher outside air infiltration rates in the living space, resulting in lower relative humidities. A better evaluation of moisture effects in minimally ventilated attics can be made during the winter months, when temperature and vapor pressure conditions are most conducive to condensation.

9.6 VAPOR BARRIERS

9.6.1 Findings

Fourteen walls (64%) and 19 ceilings (40%) in the sample had no vapor barrier. The remaining walls and ceilings were fitted with vapor barriers of treated paper, building felts, foil, polyethylene or shingles. Two wall vapor barriers were located on the inhabited side of the cavity, one in the middle of the cavity, and five on the outside of the cavity. Twenty-seven ceiling vapor barriers were located on the inhabited side of the insulation and two were located in the middle of the insulation.

A visual inspection of the sample area revealed no signs of moisture accumulation or structural degradation in any of the above cases.

9.6.2 Conclusions

As in the case of attics, vapor barriers were observed during the summer months and actual moisture accumulation was not present. Better evaluation of the effects of vapor barrier types and locations can be made during the winter months for reasons similar to those outlined under "Attic Ventilation".

9.7 CONDITION OF STRUCTURE AND WIRING

9.7.1 Findings

Every sample area was observed for deterioration of structural and wiring components. Any observed degradation of wall structure could be directly attributable to through-wall water leakage. The single observation of structural degradation in a ceiling was caused by improper owner-installed rafter insulation which had since been removed.

Electrical components observed included flexible metal conduit, ceiling backboxes behind surface mounted lights, and tube and post wiring. No evidence of degradation of any of these components due to the retrofit insulation was observed.

9.7.2 Conclusion

The materials in this sample did not noticeably affect the structure or wiring of the observed homes.

9.8 CONTRACT PERFORMANCE

9.8.1 Findings

Fifteen of the retrofits observed had an indication of level of performance. In most instances this was done by the contractor affixing a label to a roof rafter in the attic area; in the other cases, the performance was stated in contract form. Two contracts stated levels of performance by "R" factor, the remaining 13 contracts or labels stated performance only in terms of inches of material. Five of the installations were below stated performance levels and ten installations exceeded performance levels. On the average, the contractors exceeded their stated performance levels by 11 percent. Settling of loose fill material or variations in installation density could account for the majority of the work found to be less than labelled. Contract performance data is contained in Table 9.8.

9.9 RETROFIT PROBLEMS

9.9.1 Findings

No particular ceiling retrofit problems were observed. Problems were encountered in the installation of every type of wall retrofit material. These problems ranged from a total lack of insulation in the wall cavity to a partial void within the insulation. There was no particular correlation between structural barriers within the cavities (such as convection barriers, fire stops, odd framing, etc.) and problems of installation; in approximately 25% of the installations there were no structural barriers and no retrofit problems; in another 25% of the cases, there were installation problems with no structural barriers and in the remaining cases there were structural barriers and no installation problems.

Significant problems were observed in four cases. In two cases, existing insulation within the wall cavity precluded the addition of significant amounts of retrofit insulations; in two other cases little or no insulation had been installed in the wall area opened. Evidence of attempts to install retrofit insulation was present in all cases.

9.9.2 Conclusions

Because of the methods of taking the sample (approximately four square feet of the entire wall area) no conclusions as to the overall installation can be drawn. Problems were observed in less than 15% of all observations and no out right attempts at fraud or misrepresentation on the part of the contractor were evident.

9.10 SETTLING

9.10.1 Finding

No determination of settling in walls or ceilings was determined. In walls, openings were made near grade level, and no noticeable difference in density was observed between the top and the bottom of the opening. In ceilings, the installed thickness of the retrofit insulation was usually not known. The measured depth of retrofit insulation in those ceilings labelled for installed thickness exceeded the original stated depth in nine cases while measuring less than the stated depth four times.

9.10.2 Conclusions

More extensive evaluation of the installation of the retrofit insulations and the potential for settling - particularly in loose fill insulations - should be made. This can be economically accomplished through the use of thermography. Representative areas of voids or settling should then be opened for further observation and testing.

TABLE 9.8 CONTRACT PERFORMANCE

Sample Number	Retro Age	Material	Retrofit Label	Measured Retrofit Thickness	Measured Total "R" Insulation	Measured "R" per inch Insulation	Density
19C	3	GF	6"	6.50"	20 +	3.05	2.40
20C	3	GF	6" reblow	7.50"	23 +	3.05	2.10
21C	2.2	C	R-22	10.13"	34 +	3.40	1,80
22C	14	GF	10"	7.35	22 -	3.05	3.40
35C	2	GF	19 bags 1232 s.f. 6" reblow	7.75	23 +	3.00	2.35
37C	2	GF	15 bags 988 s.f. 6" reblow	10.00	30 +	2.95	1.40
43C	3.5	GF	6" reblow	9.25	30 +	3.25	1.70
45C	3.2	GF	6" reblow	4.30	16 -	3.70	2.40
46C	2	GF	8" reblow	8.50	28 +	3.25	1.40
47C	3	GF	6" reblown glass fiber	6.50	22 +	3.45	2.30
48C	3	GF	6" additional	6.75	21 +	3.15	1.60
50C	3	GF	6" blown glass fiber	5.50	20 -	3.70	2.95
53C	3.3	GF	6" reblow	5.50	19 -	3.45	3.55
54C	3	GF	6"	8.00	27 +	3.35	2.35
55C	2.5	C	40 bags 1000 s.f. R-24	5.25	17 -	3.25	3.80

NOTES:

Material

GF = Glass Fiber
C = Cellulose

10. REFERENCES

1. R. W. Anderson and P. Wilkes, ERDA 77-23 UC-95d, January, 1977.

2. D. M. Burch and C. M. Hunt, "Retrofitting an Existing Wood Frame Residence for Energy Conservation - An Experimental Study", NSSIR 77-1274, July, 1977.

3. W. J. Rossiter, Jr.; R. G. Mathey; D. M. Burch; and E. T. Pierce NBS Technical Note 946, July, 1977.

4. R. P. Tye, Journal of Testing and Evaluation, Volume 2, No. 3, May, 1974, "Heat Transmission in Cellulosic Fiber Insulation Material".

5. ASTM C421, 1971 Volume 18, "Mechanical Stability of Pre-formed Thermal Insulation by Tumbling".

6. ASTM C518, 1976 Volume 18, "Steady-State Thermal Transmission Properties by Means of a Heat Flow Meter".

7. Minimum Property Standards, One and Two Family Dwellings 4900.1, 1973 Edition, Revision #4, March, 1976; United States Department of Housing and Urban Development.

11. APPENDIX I - FIELD WORKSHEETS

Sample Number	Wall	Ceiling
1	X	X
2	X	
3	X	
4	X	
5	X	
6	X	
7	X	
8	X	X
9	X	X
10	X	X
11	X	X
12	X	X
13	X	X
14		X
15	X	a.X b.X
16	X	X
17	X	X
18	X	X
19		X
20		X
21		X
22		X
23	X	X
24	X	X
25	X	X
26	X	X
27	X	X

Sample Number	Wall	Ceiling
28		X
29		X
30		X
31		X
32		X
33		X
34		X
35		X
36		X
37		X
38	X	X
39		X
40	X	
41	X	
42		X
43		X
44		X
45		X
46		X
47		X
48		X
49		X
50		X
51		X
52		X
53		X
54		X
55		X

MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME
ADDRESS
PHONE

SAMPLE NO. 1 WALL
DATE 9 June, 1977
SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit ½ yr. house 42 ORIENTATION north
HEAT SYSTEM gas H.W. INSTALLER & DATE Dec. 76

FIELD OBSERVATIONS

plan location(s) closet venting N/A
framing type 2 X 4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type rock wool vapor barrier type paper
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems stucco house

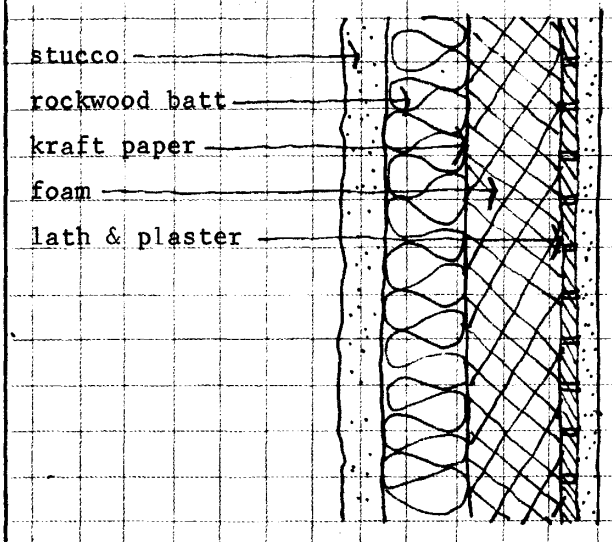
difficulty of opening/closing sample lath & plaster interior difficult to open

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
wood fibers on back of foam quite wet
packing N/A friability N/A
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS

insulation thickness 3½" flame char/no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



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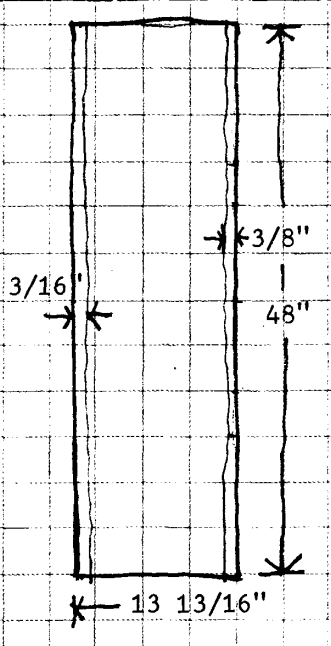


ELEVATION

SHRINKAGE = 4%

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME
ADDRESS
PHONE

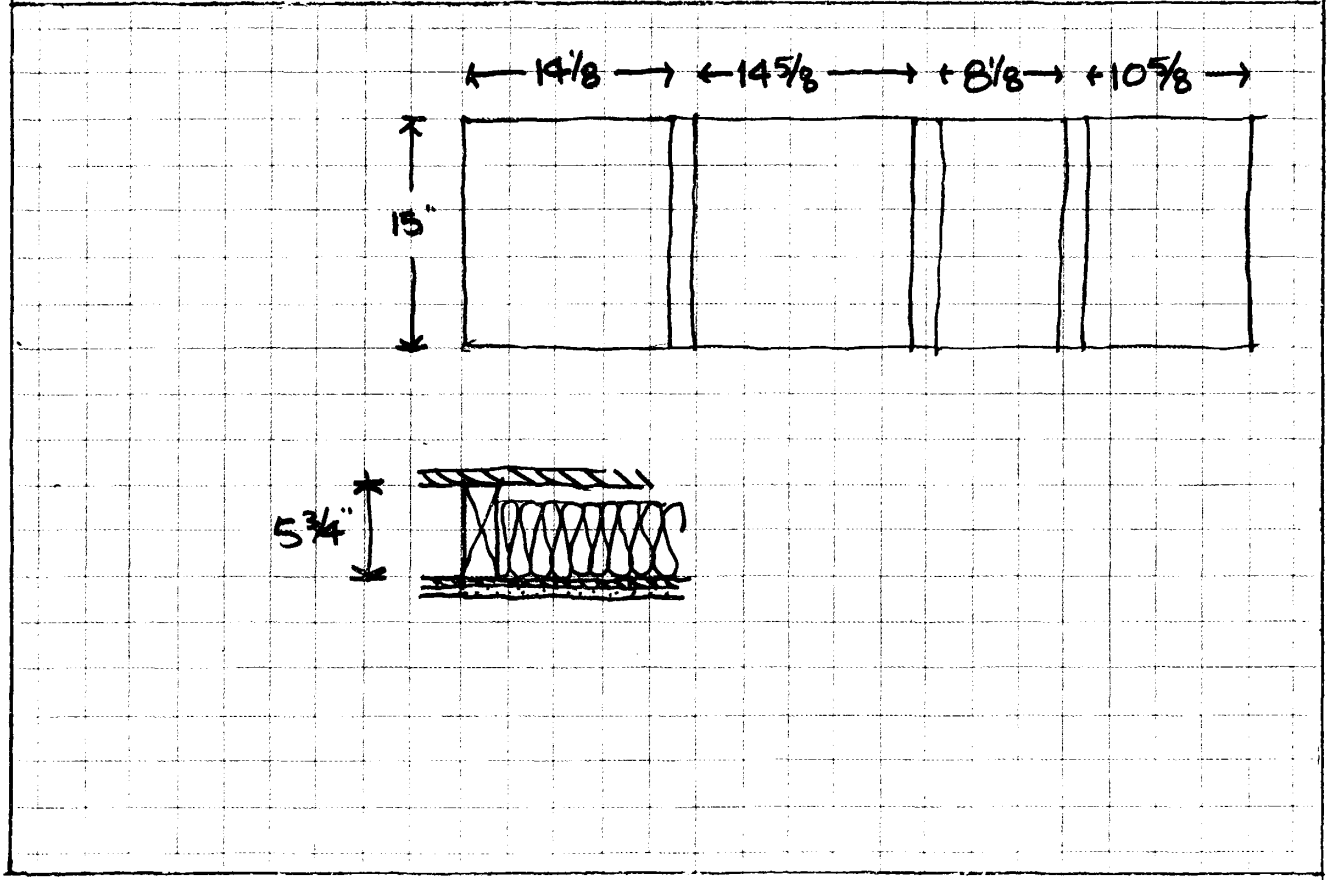
SAMPLE NO. 1 CEILING
DATE 9 June, 1977
SOURCE OF LEAD volunteeer

GENERAL
AGE: retrofit ½ yr. house 42 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE Nov. 1976

FIELD OBSERVATIONS
knocked out 2 windows - roof
plan location(s) bedroom
venting vents to be installed
framing type joist/rafter
condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems floor boards
difficulty of opening/closing sample floor boards
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing ok friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 4 5/8" flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 2 WALL
ADDRESS _____ DATE 9 June, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 2 yrs house 80 ORIENTATION north
HEAT SYSTEM changed from gas to electic last year INSTALLER & DATE March 1975

FIELD OBSERVATIONS

plan location(s) living room venting N/A
framing type 2 X 4 stud - balloon condition of structure good
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems 3/4" blow hole - plaster droppings in cavity
difficulty of opening/closing sample none

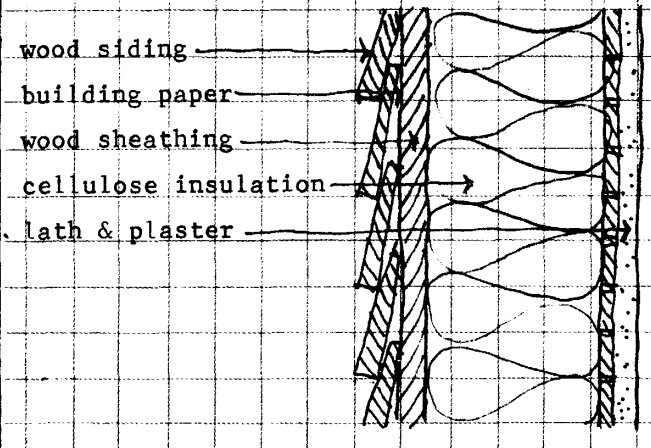
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
cellulose slightly damp
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS

insulation thickness 4" average flame chars, does not burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)

NOTE: packed tight at bottom, swelling at top



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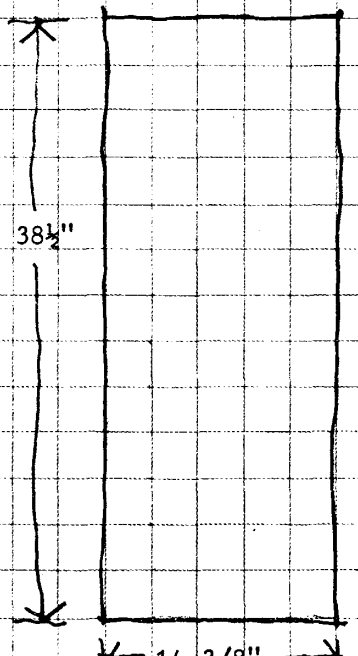


ELEVATION

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 3 WALL
ADDRESS _____ DATE 9 June, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit house 27 ORIENTATION north
HEAT SYSTEM F.A. INSTALLER & DATE unknown

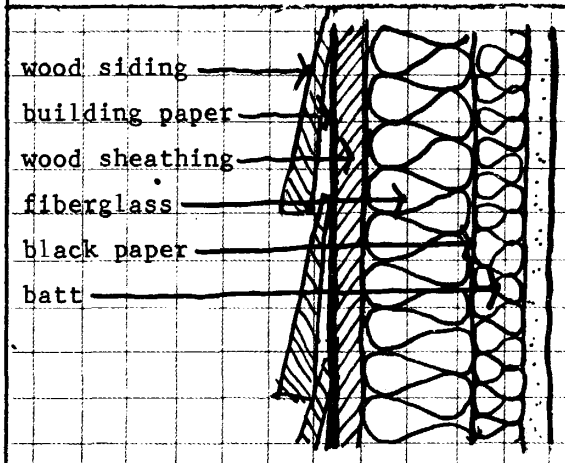
FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type 2 X 4 stud condition of structure excellent
condition of wiring good
ORIGINAL: insulation type wood fibre batt vapor barrier type paper
RETROFIT: insulation type fiberglass vapor barrier type N/A
retrofit installation procedures/problems did not fill corner

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness 2.97" average flame chars, especially batt

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



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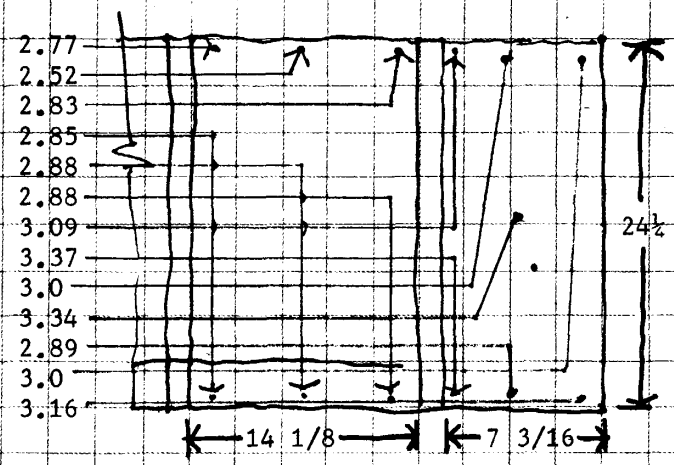


ELEVATION

MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME _____ SAMPLE NO. 4 WALL
ADDRESS _____ DATE 9 June, 1977
PHONE _____ SOURCE OF LEAD VOL.

GENERAL

AGE: retrofit 2 yrs house 71 ORIENTATION south
HEAT SYSTEM N/A INSTALLER & DATE 1975

FIELD OBSERVATIONS

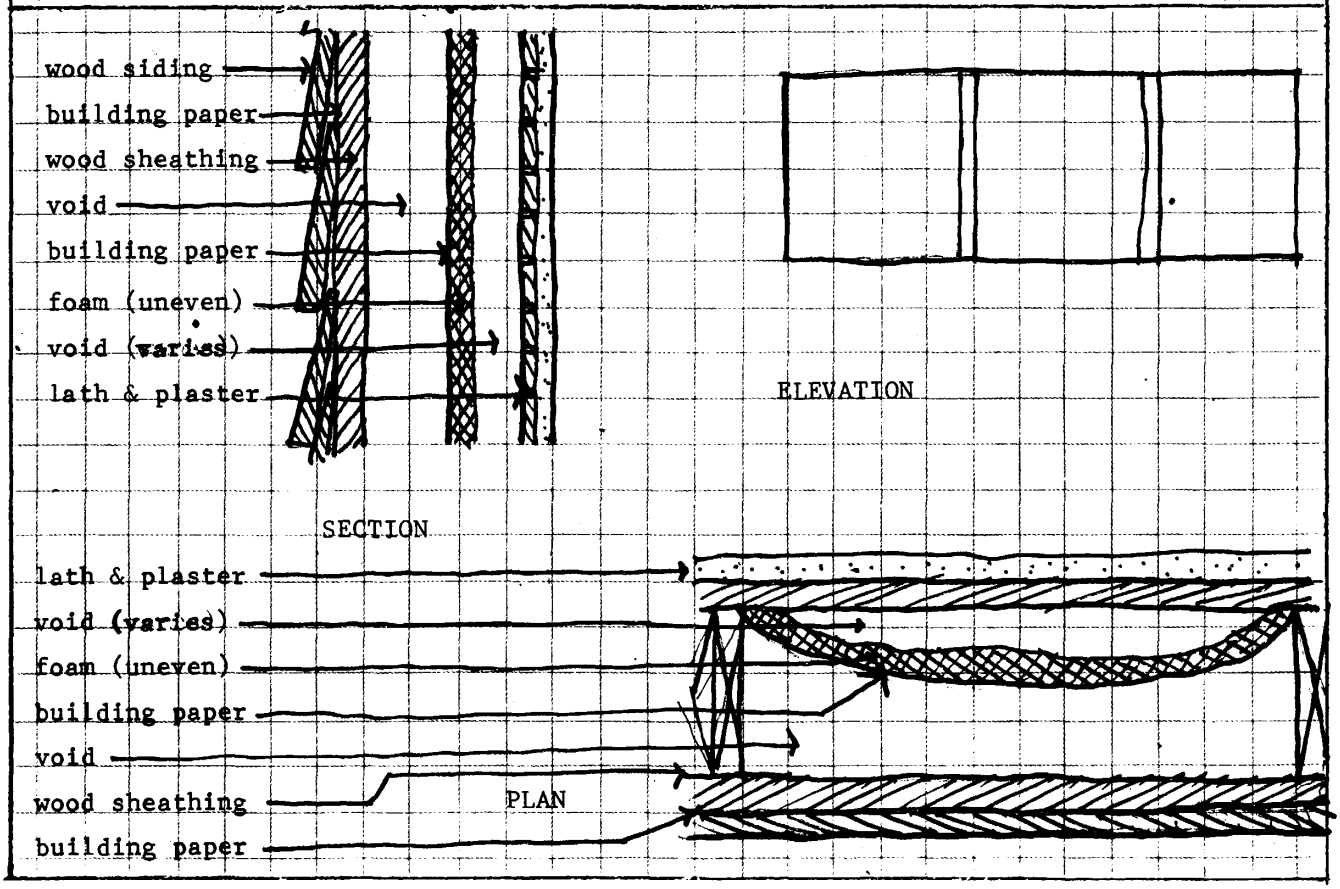
plan location(s) stair venting N/A
framing type balloon condition of structure good
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type NONE
RETROFIT: insulation type foam vapor barrier type NONE
retrofit installation procedures/problems foam not in all cavities - cavities not filled due to location of building paper
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability N/A
REPLACEMENT: insulation N/A vapor barrier none

FIELD TESTS

insulation thickness none flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 5 WALL
ADDRESS _____ DATE 10 June, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 3 yrs house 25 ORIENTATION west
HEAT SYSTEM H.W. INSTALLER & DATE June 1974

FIELD OBSERVATIONS

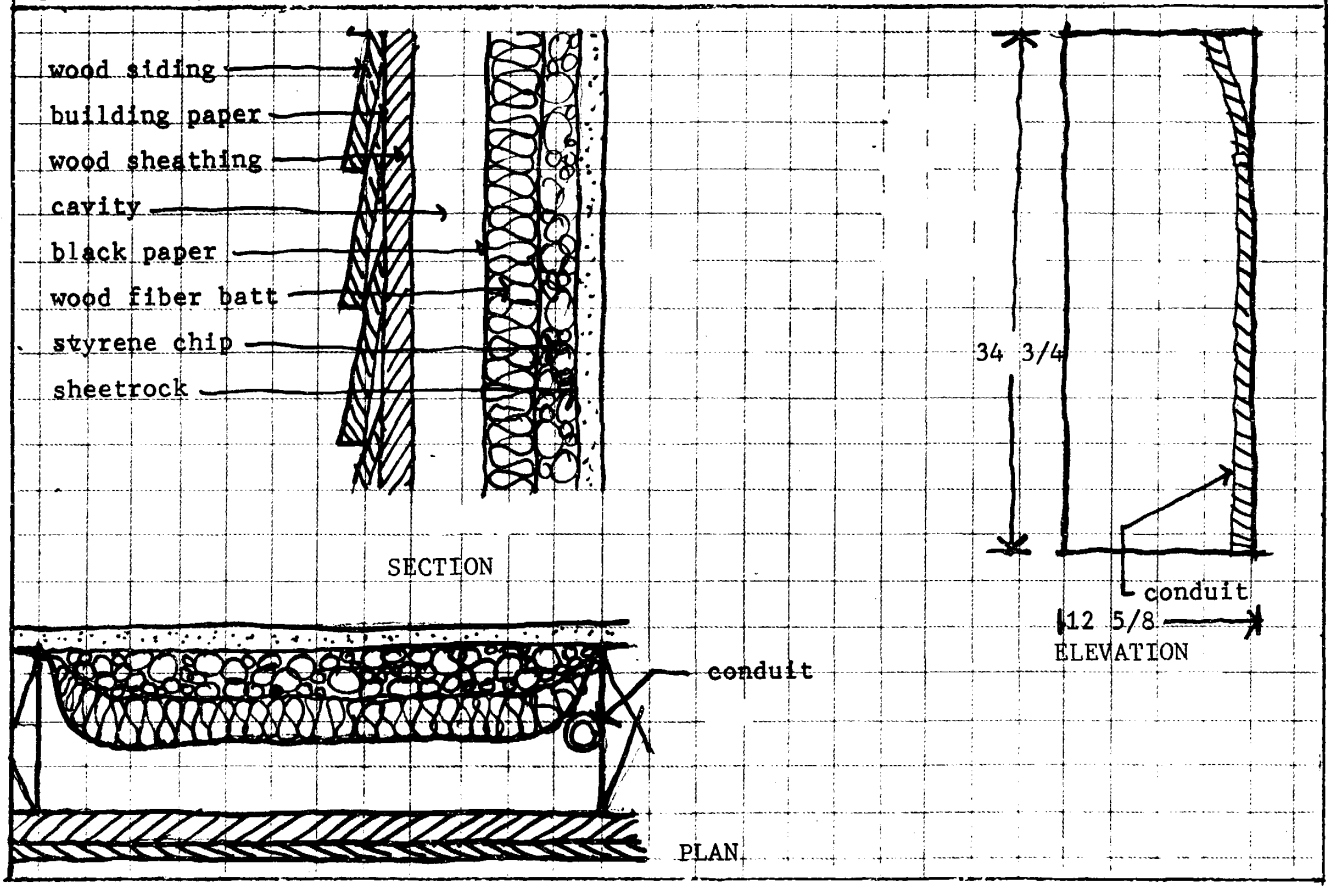
plan location(s) bedroom venting N/A
framing type 2 X 4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type wood fiber batt vapor barrier type poly
RETROFIT: insulation type styrene pellets vapor barrier type none
retrofit installation procedures/problems pellets blown inside batt - compressed batt. Did not fill cavity.
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability N/A
REPLACEMENT: insulation fiberglass vapor barrier original left intact

FIELD TESTS

insulation thickness N/A flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

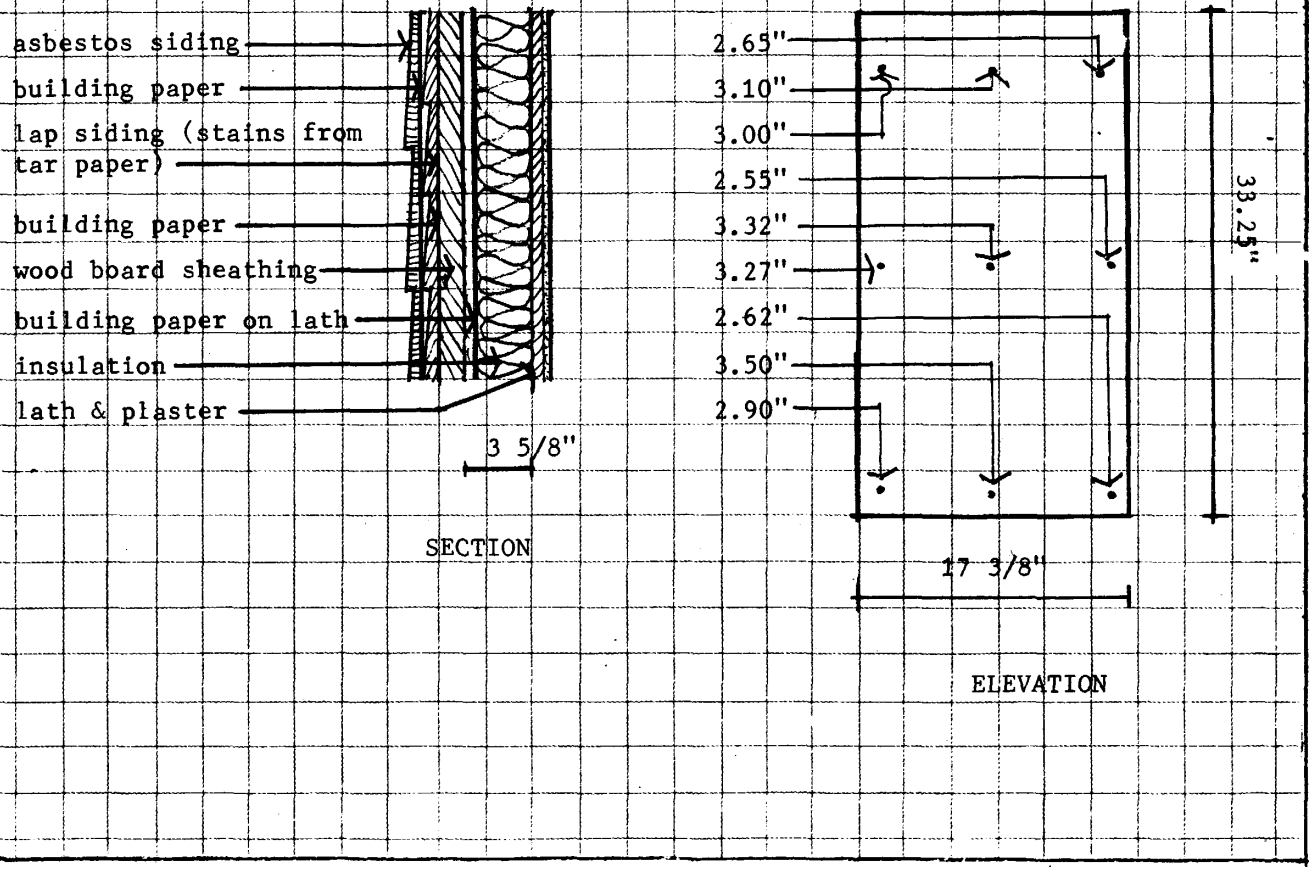
NAME _____ SAMPLE NO. 6 WALL
ADDRESS _____ DATE 23 June, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 1.75 yr. house 60 (est.) ORIENTATION north
HEAT SYSTEM H.W. INSTALLER & DATE August 1975

FIELD OBSERVATIONS
plan location(s) hall venting N/A
framing type 2X4 studs condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type bldg paper
RETROFIT: insulation type cellulose vapor barrier type NONE
retrofit installation procedures/problems blown cellulose between plaster lath & bldg paper - removed siding to insert - 1 hole top & bottom of cavity
difficulty of opening/closing sample multiple layers caused some difficulty - 1 hr to open, ½ to close Total time 1½ hrs on site (½ due to checking ceiling)
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier NONE

FIELD TESTS
insulation thickness 2.99" Avg. flame char, does not support combustion

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME _____ SAMPLE NO. 7 WALL
ADDRESS _____ DATE 5 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit 2 yrs house 1959 ORIENTATION north
HEAT SYSTEM F.A. INSTALLER & DATE July, 1975

FIELD OBSERVATIONS

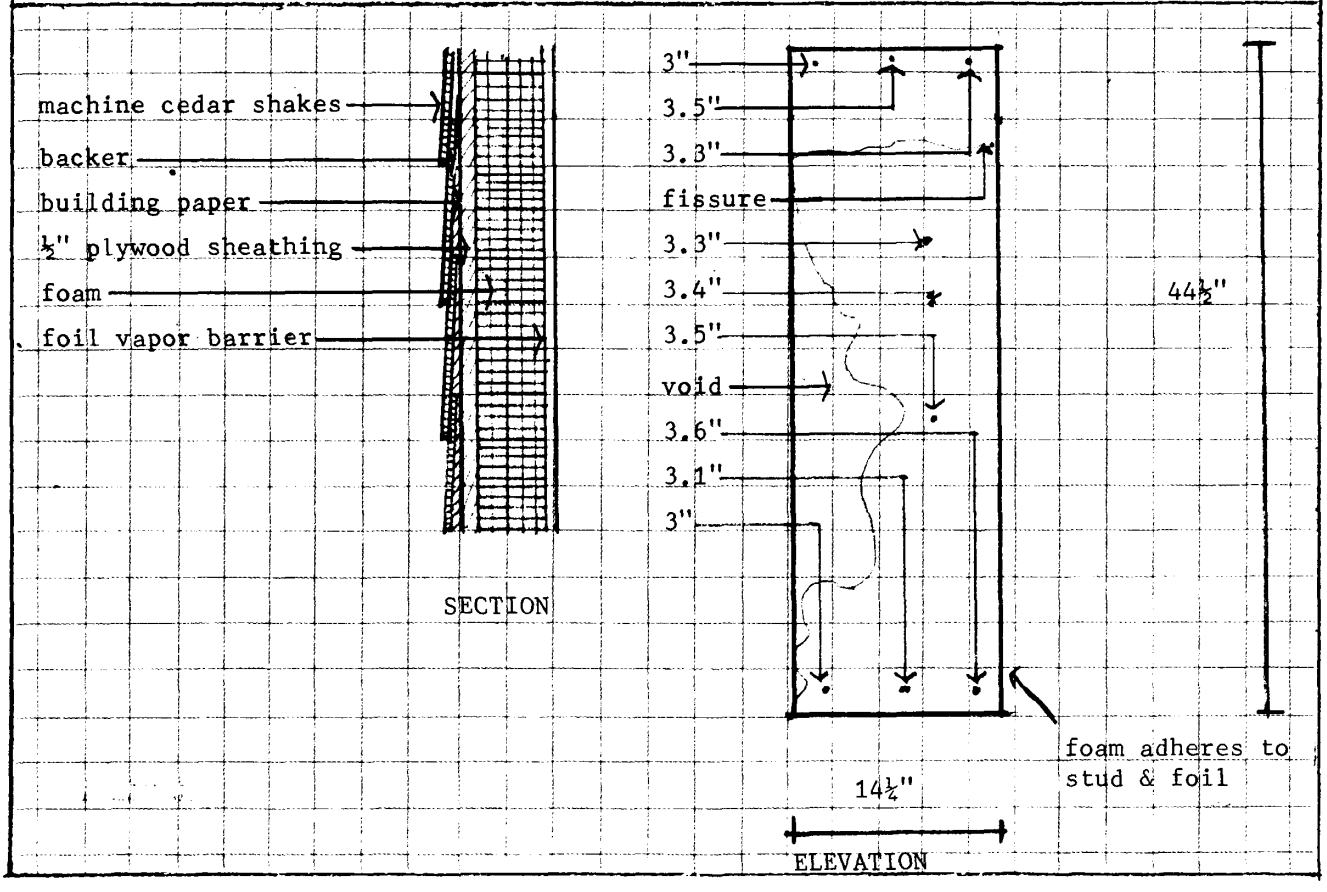
plan location(s) bedroom venting N/A
framing type 2x4 condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type foil
RETROFIT: insulation type U.F. vapor barrier type N/A
retrofit installation procedures/problems 1½" hole midway up wall - single per cavity - did not fill cavity
difficulty of opening/closing sample shingles fragile (1½ hours)

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing did not pack dowm V.B. friability OK spongy-integral
REPLACEMENT: insulation U.F. vapor barrier left intact

FIELD TESTS

insulation thickness 3.3 average flame chars, does not support combustion

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME
ADDRESS
PHONE

SAMPLE NO. 8 WALL
DATE 13 July, 1977
SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 1 yr house 50 ORIENTATION south-porch
HEAT SYSTEM F.A. INSTALLER & DATE unknown

FIELD OBSERVATIONS

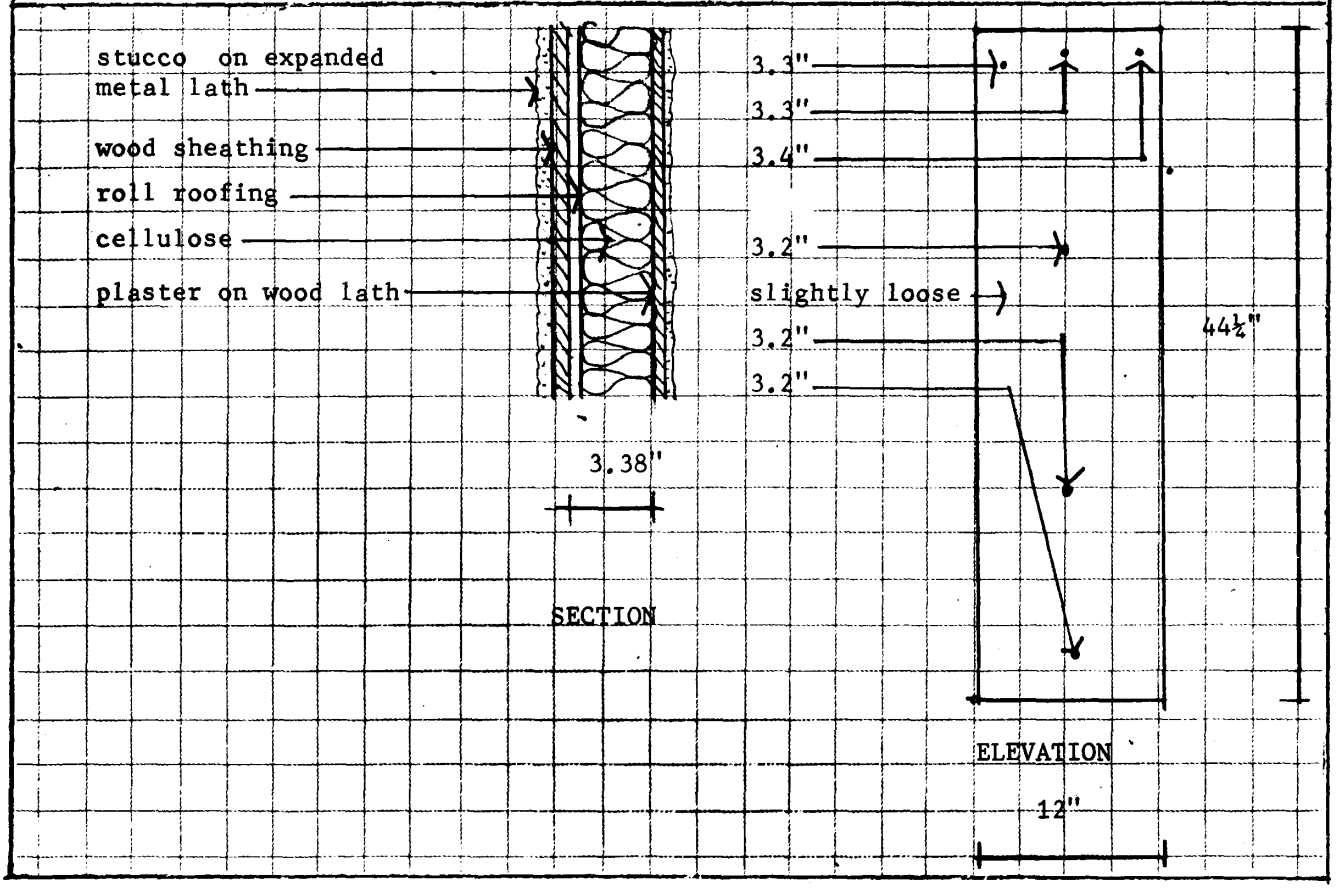
plan location(s) bedroom venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type NONE
RETROFIT: insulation type cellulose vapor barrier type NONE
retrofit installation procedures/problems stucco/framing @ door not filled (no way to get to it)
difficulty of opening/closing sample stucco over lath 2 hrs

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier NONE

FIELD TESTS

insulation thickness 3.27" flame chars

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 8 CEILING
ADDRESS _____ DATE 13 July, 1977
PHONE _____ SOURCE OF LEAD NSP

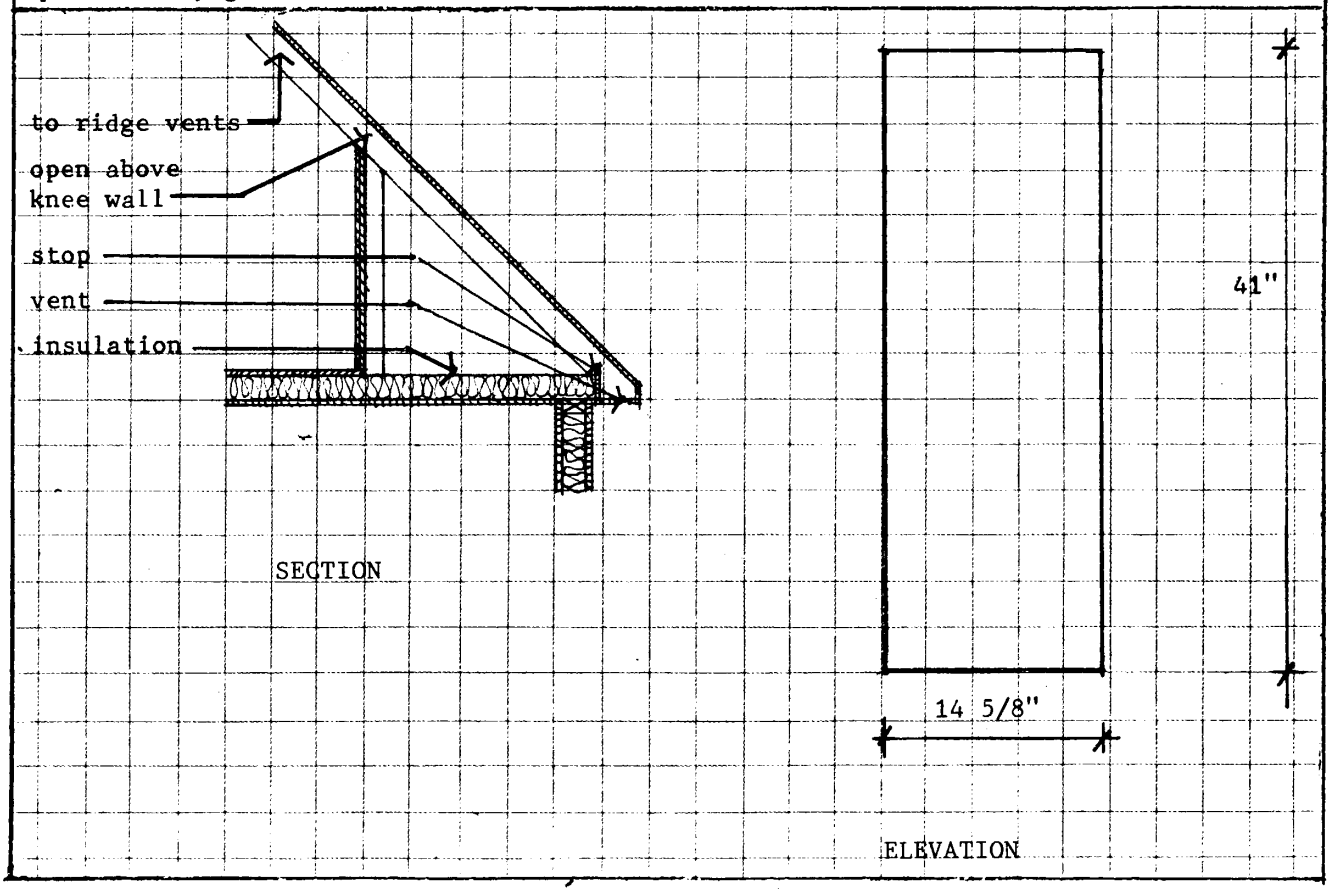
GENERAL
AGE: retrofit unknown house 50 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE unknown

FIELD OBSERVATIONS
plan location(s) bedroom venting 4 9" vents
framing type 6" joints 2x4 rafters condition of structure good w/sm
condition of wiring N/A deter @ stop boards (photo)
ORIGINAL: insulation type NONE vapor barrier type NONE
RETROFIT: insulation type blown mineral wool vapor barrier type none
retrofit installation procedures/problems some partial voids due to filling & subsequent removal of floor boards
difficulty of opening/closing sample 1 hour

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing slightly loose friability N/A
REPLACEMENT: insulation glass batt vapor barrier none

FIELD TESTS
insulation thickness 5" flame no char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME
ADDRESS
PHONE

SAMPLE NO. 9 WALL
DATE 13 July, 1977
SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 2 house 27 ORIENTATION north
HEAT SYSTEM F.A INSTALLER & DATE 1975

FIELD OBSERVATIONS

plan location(s) bedroom venting N/A
framing type 2-4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type batt glass vapor barrier type paper
RETROFIT: insulation type mineral wool vapor barrier type N/A
retrofit installation procedures/problems No retrofit at window rough-in

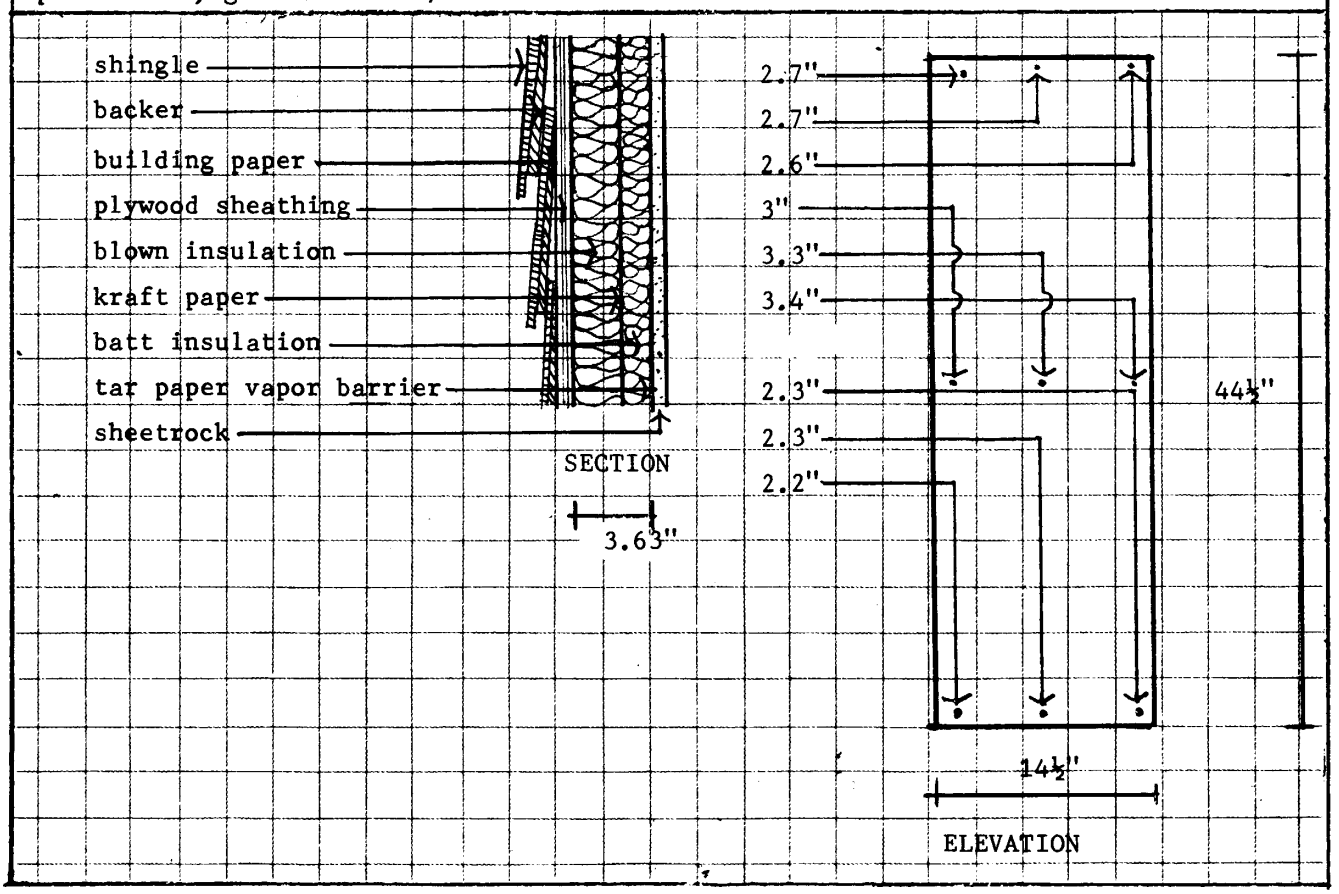
difficulty of opening/closing sample shingles fragile

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiber glass vapor barrier building paper

FIELD TESTS

insulation thickness 2.7" flame no char, no flame

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME _____ SAMPLE NO. 9 CEILING
ADDRESS _____ DATE 13 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 27 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE 1975

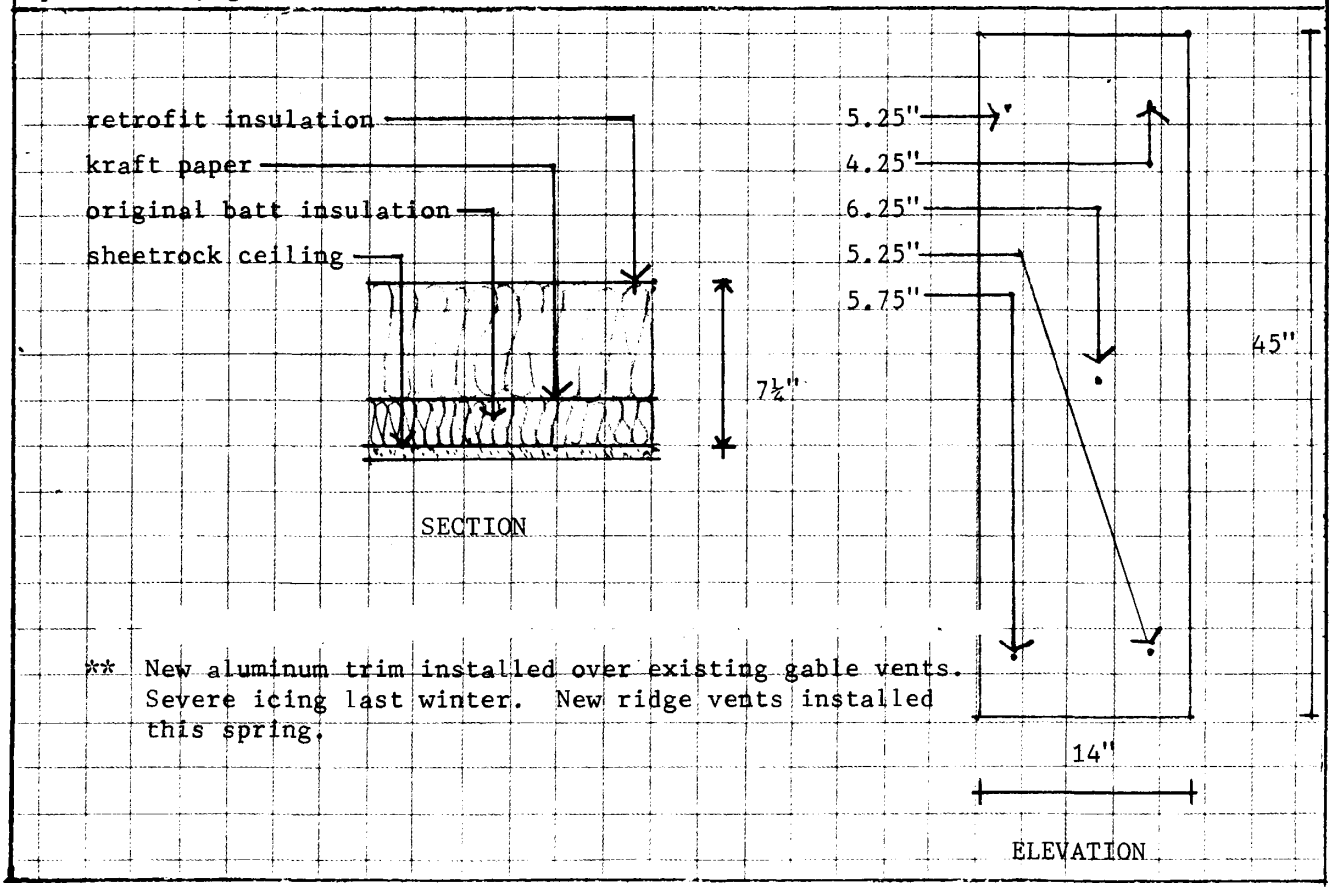
FIELD OBSERVATIONS
plan location(s) bedroom venting 2-ridge 6"X8", very small gable
framing type joist & rafter condition of structure excellent
condition of wiring appeared good
ORIGINAL: insulation type batt vapor barrier type none
RETROFIT: insulation type blown glass vapor barrier type none
retrofit installation procedures/problems NONE **

difficulty of opening/closing sample NONE

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing OK friability N/A
REPLACEMENT: insulation fiber glass * vapor barrier none

FIELD TESTS
insulation thickness 5.4" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



** New aluminum trim installed over existing gable vents. Severe icing last winter. New ridge vents installed this spring.

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 10 WALL
ADDRESS _____ DATE 14 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1 yr 2 moshouse 89 ORIENTATION north
HEAT SYSTEM H.W. INSTALLER & DATE Feb. 1976

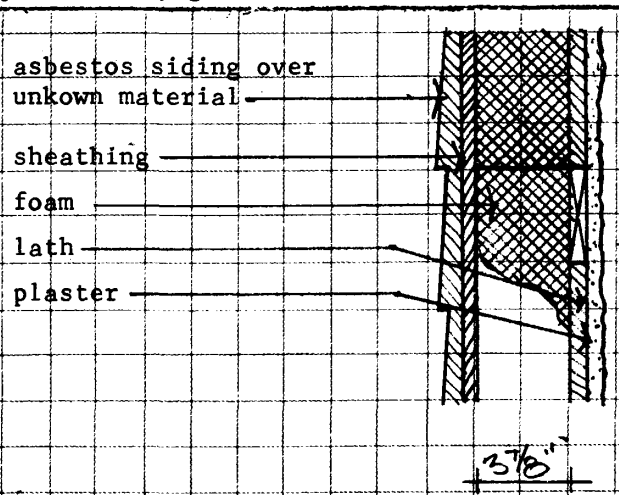
FIELD OBSERVATIONS
plan location(s) entry venting N/A
framing type 2X4 - odd/balloon condition of structure fair/poor
condition of wiring OK - old
ORIGINAL: insulation type NONE vapor barrier type NONE
RETROFIT: insulation type UF vapor barrier type NONE
retrofit installation procedures/problems odd framing - voids not filled

difficulty of opening/closing sample cutting through lath 1½

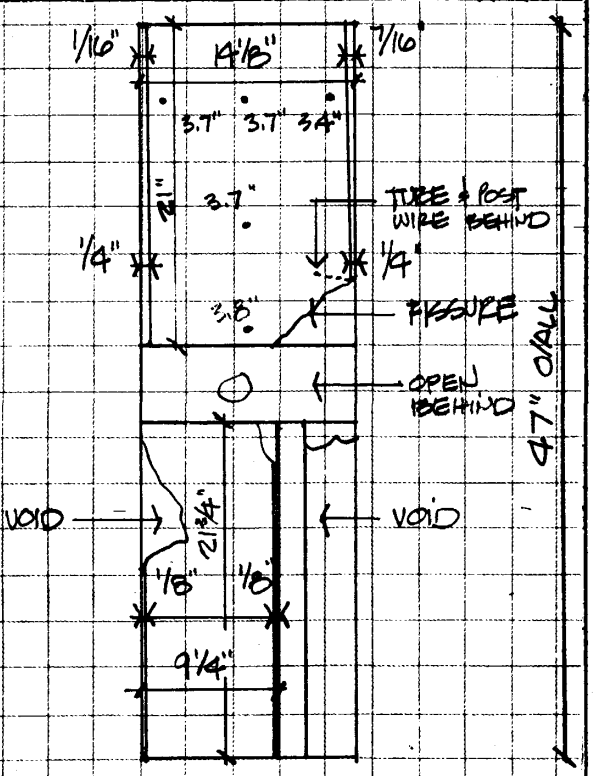
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
moisture in wood - fungus (orange growth)*- musty odor on wood
packing N/A friability some, not bad
REPLACEMENT: insulation foam vapor barrier none

FIELD TESTS
insulation thickness varies - 3.7" flame chars - no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



ELEVATION

*NOTE: presence of leak in general wall area.
Small part of foam discolored & friable

SHRINKAGE = 4%

NOTE: other areas of exposed wall in house indicate only partial filling of cavities

MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME _____ SAMPLE NO. 10 CEILING
ADDRESS _____ DATE 14 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1yr 2mos house 89 ORIENTATION north
HEAT SYSTEM H.W. INSTALLER & DATE Feb. 1976

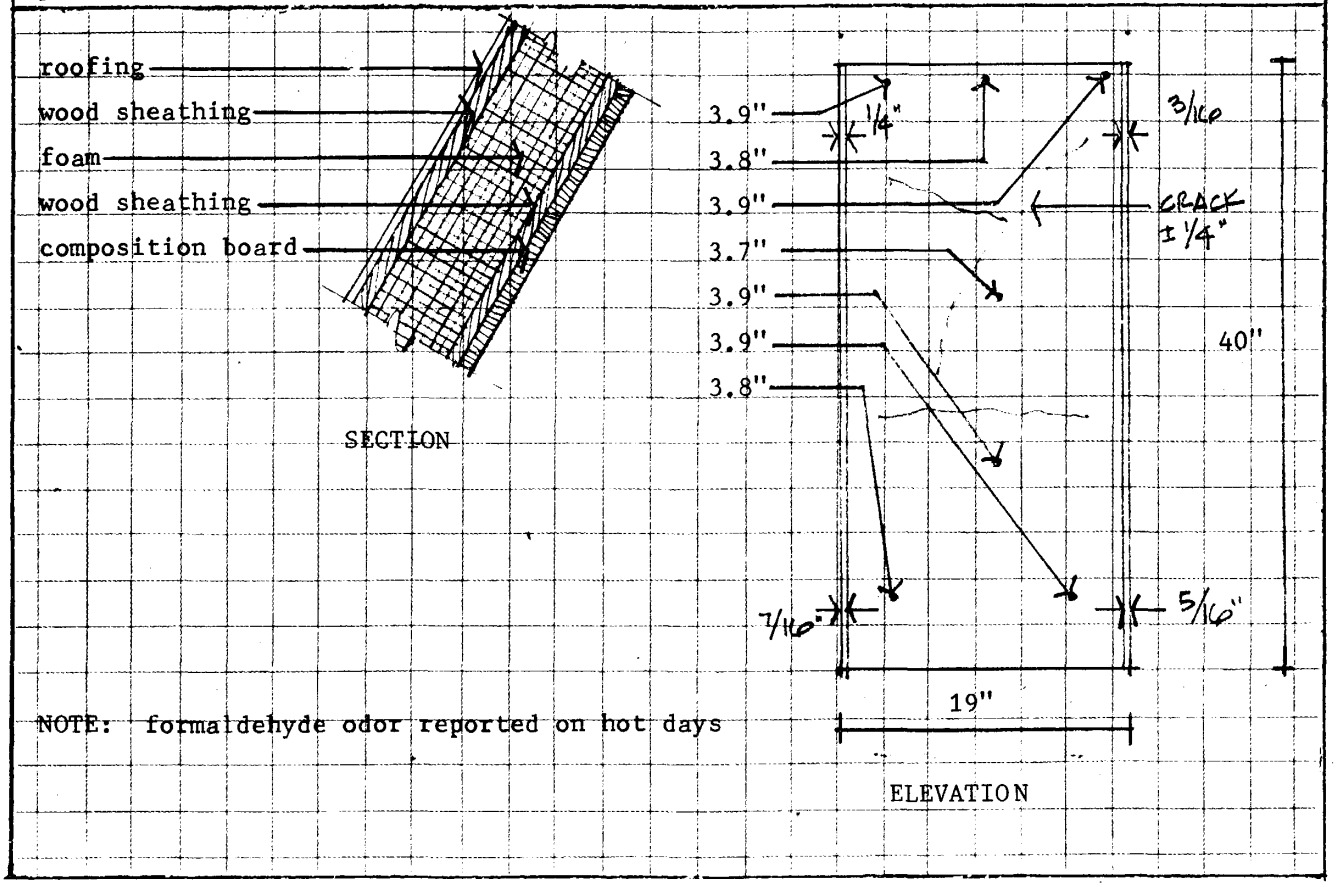
FIELD OBSERVATIONS
plan location(s) attic - roof venting NONE
framing type rafter condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems scab boards - foam filled around

difficulty of opening/closing sample 1½ hrs - odd frame

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing N/A friability good
REPLACEMENT: insulation foam vapor barrier none

FIELD TESTS
insulation thickness 3.8" flame chars, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: formaldehyde odor reported on hot days

MINNESOTA ENERGY AGENCY
INSULATION TEST WORK T

NAME _____ SAMPLE NO. 11 WALL
ADDRESS _____ DATE 14 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 yrs house 50+ ORIENTATION south
HEAT SYSTEM H.W. INSTALLER & DATE Aug. 1974

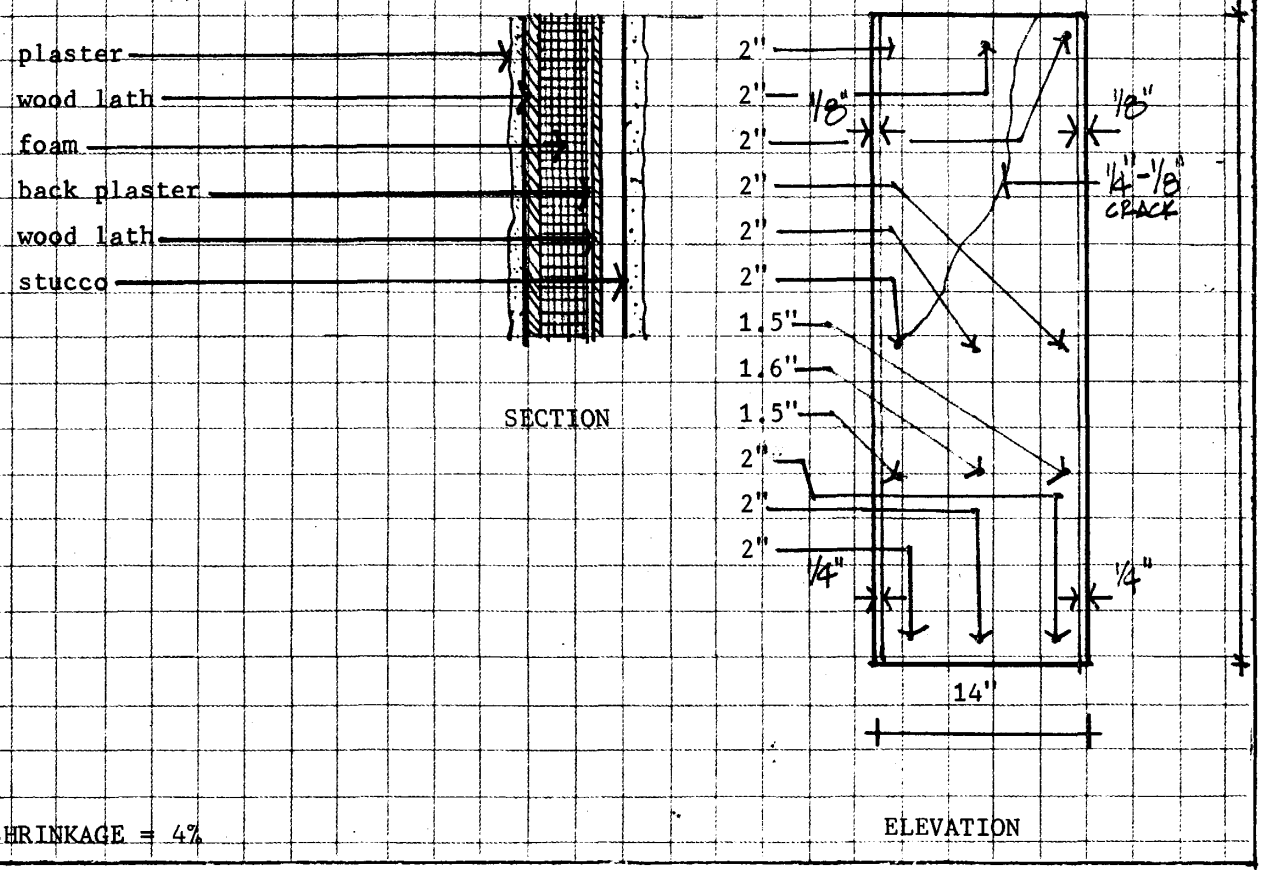
FIELD OBSERVATIONS
plan location(s) kitchen venting NONE
framing type 2x4 back plaster condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems back plaster

difficulty of opening/closing sample cutting through lath & plaster

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing N/A friability good
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS
insulation thickness 1.88" flame chars, does not burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SHRINKAGE = 4%

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 11 CEILING
ADDRESS _____ DATE 14 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 3 yrs house 50+ ORIENTATION south
HEAT SYSTEM H.W. INSTALLER & DATE Aug. 1974

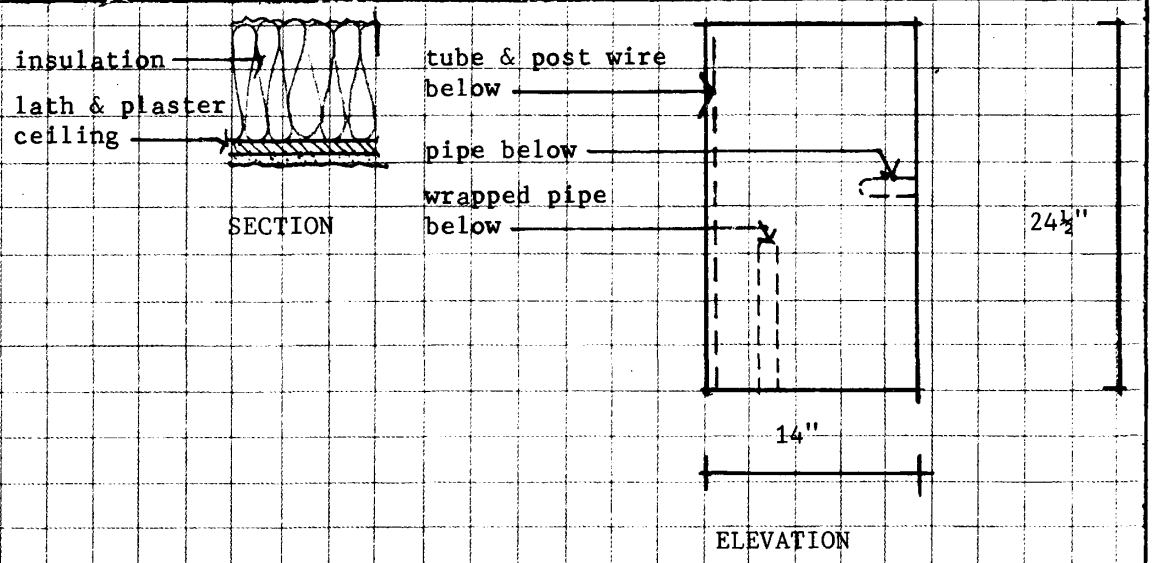
FIELD OBSERVATIONS

plan location(s) bathroom venting NONE (owner to do)
framing type rafters & joist condition of structure excellent
condition of wiring good (tube & post)
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems installation uneven - reported squirrels in attic
difficulty of opening/closing sample much wood, plaster, debris in bottom of cavity
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
product dry - uneveness may be due to squirrels
packing OK friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS

insulation thickness 5½" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



uneven job, one of the best cavities chosen
tube & post wiring found fairly good condition but exposed

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 12 WALL
ADDRESS _____ DATE 26 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit .75 yr house 95+ ORIENTATION north
HEAT SYSTEM forced air INSTALLER & DATE Oct 1976

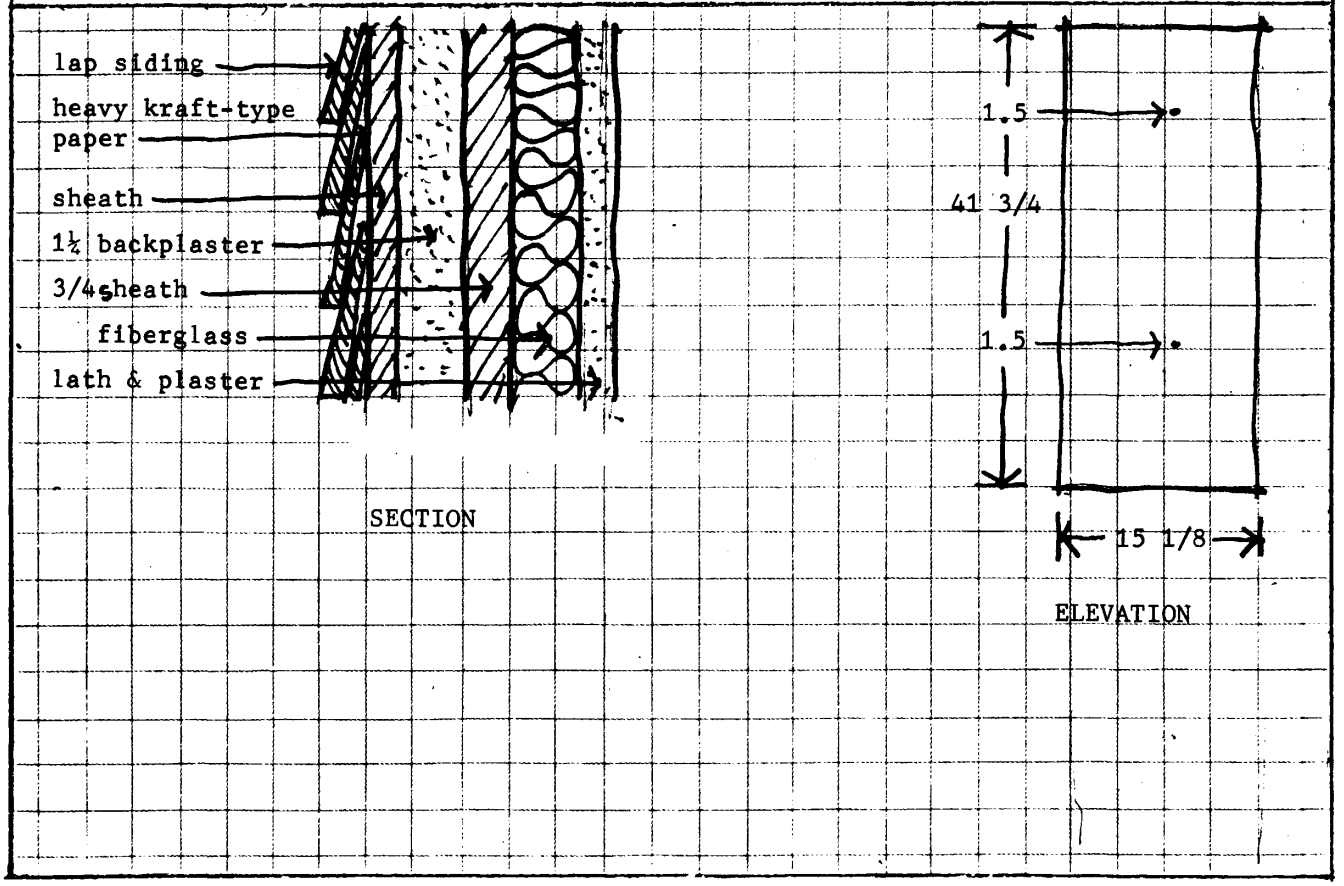
FIELD OBSERVATIONS
plan location(s) laundry venting dryer vent
framing type 2X4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type None
RETROFIT: insulation type fiberglass vapor barrier type None
retrofit installation procedures/problems heavy backplaster

difficulty of opening/closing sample multiple layers - 2 hours

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
recent rain - siding wet @ window edge, sheathing also
packing loose friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS
insulation thickness 1½" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 12 CEILING
ADDRESS _____ DATE 26 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit .75 house 95 ORIENTATION N/A
HEAT SYSTEM forced air INSTALLER & DATE September 1976

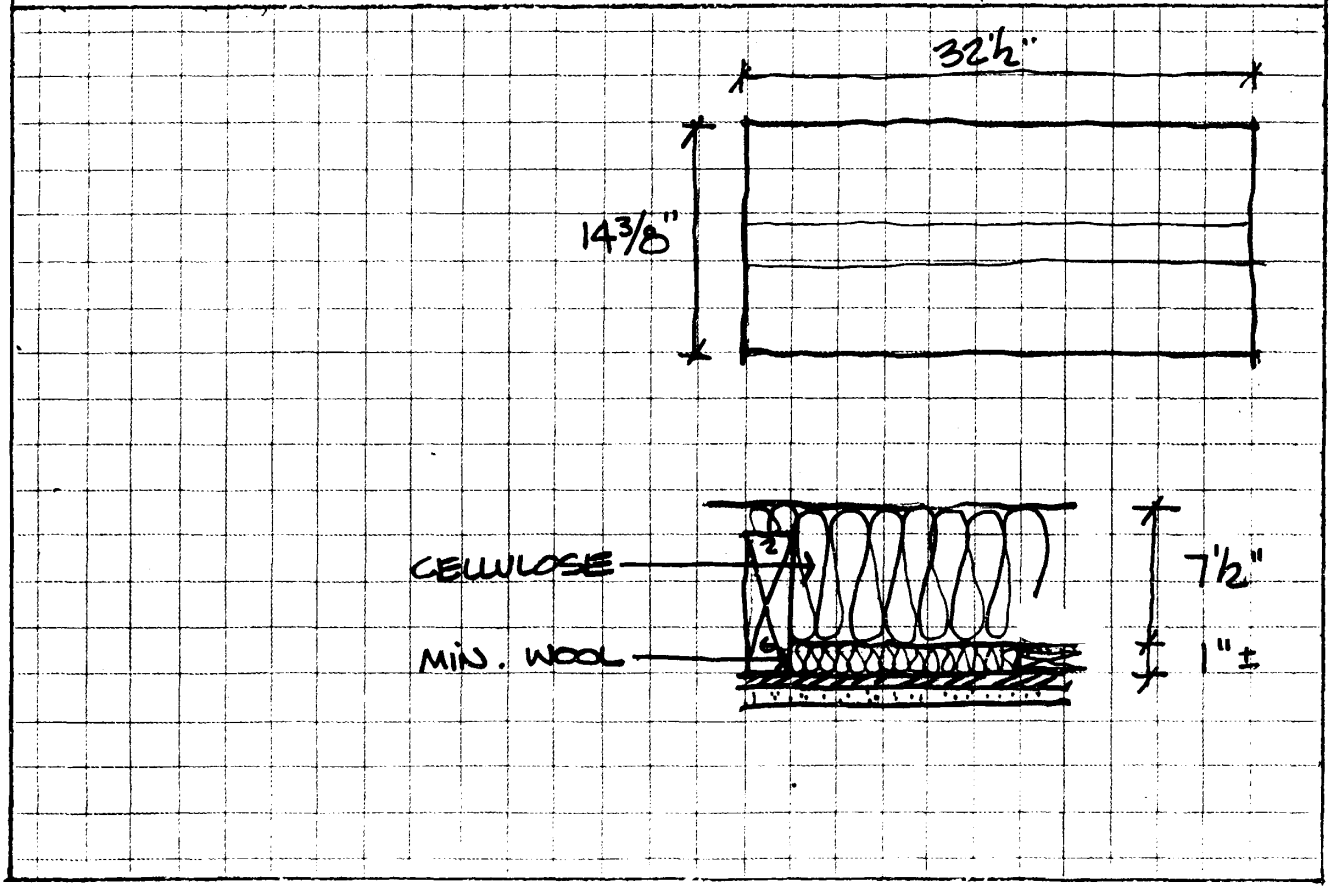
FIELD OBSERVATIONS
plan location(s) bedroom venting 2 - 8X10 ridge - eave open
framing type rafter & joist condition of structure good
condition of wiring good - tube & post
ORIGINAL: insulation type mineral wool vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS
insulation thickness see below flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 13 WALL
ADDRESS _____ DATE 26 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

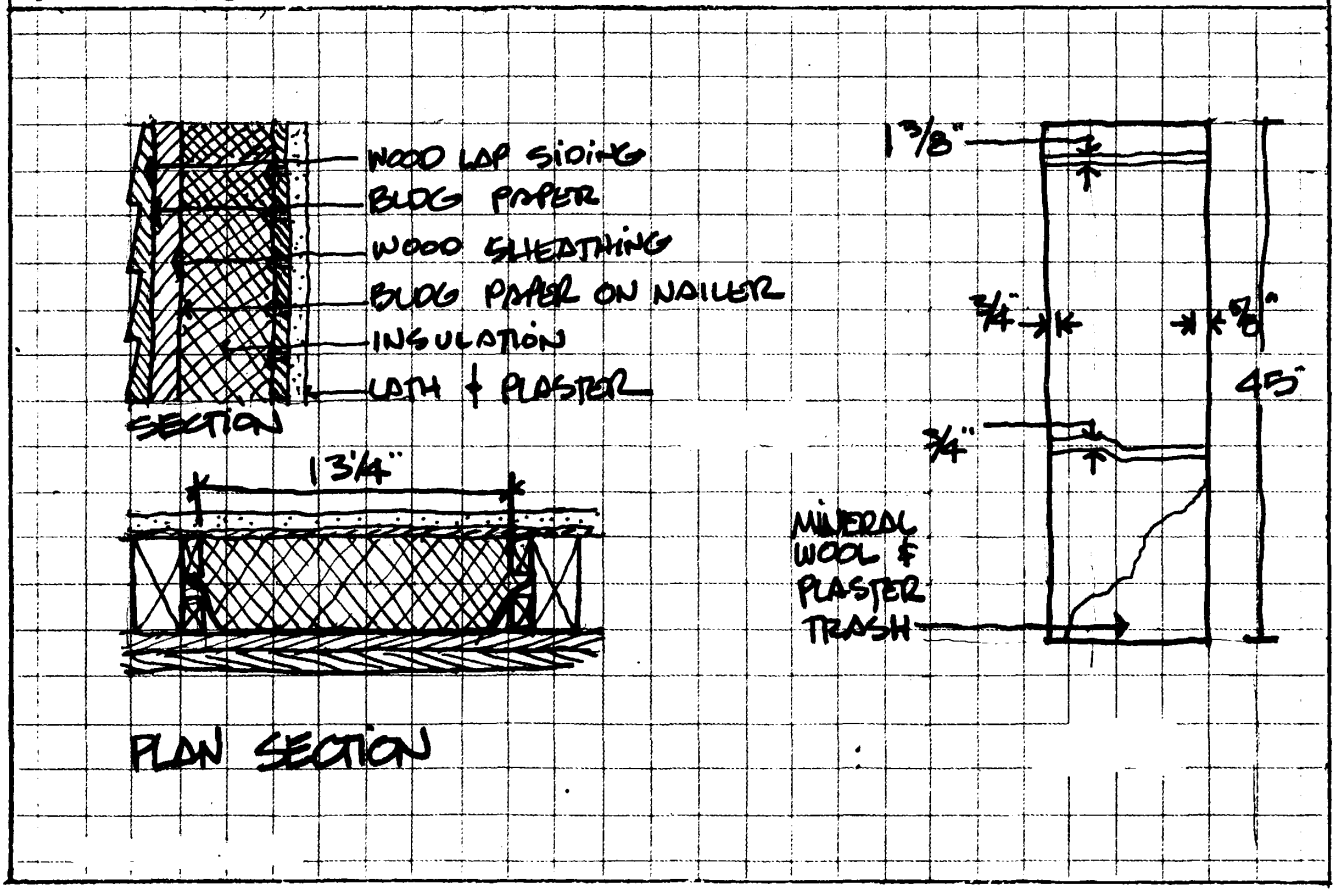
GENERAL
AGE: retrofit 1½ house 75+ ORIENTATION north
HEAT SYSTEM forced air INSTALLER & DATE January 1976

FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type 2X4 studs condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type rockwool vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems material in cavity - tar barrier
installer used 2 entries per cavity per story
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing N/A friability good
REPLACEMENT: insulation UF vapor barrier NONE

FIELD TESTS
insulation thickness 3.27" flame char/no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 13 CEILING
ADDRESS _____ DATE 26 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1½ house 75+ ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE January 1976

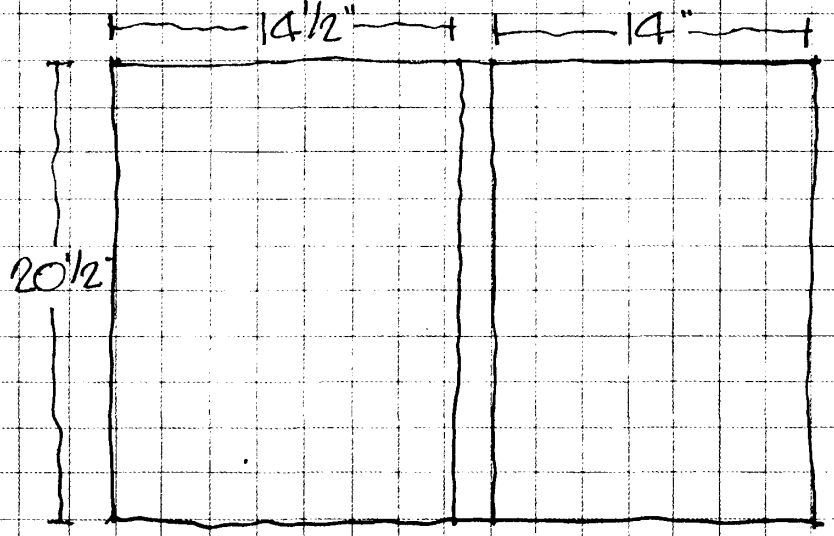
FIELD OBSERVATIONS
plan location(s) bedroom venting no eave - no stops gable window/ no ridge
framing type joist/rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type rockwool vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems floorboards

difficulty of opening/closing sample floor boards

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing moderate friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 4.48" total flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 14 CEILING
ADDRESS _____ DATE 27 July 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit over 10 house 65 ORIENTATION bedroom
HEAT SYSTEM H W. rad INSTALLER & DATE unknown

FIELD OBSERVATIONS

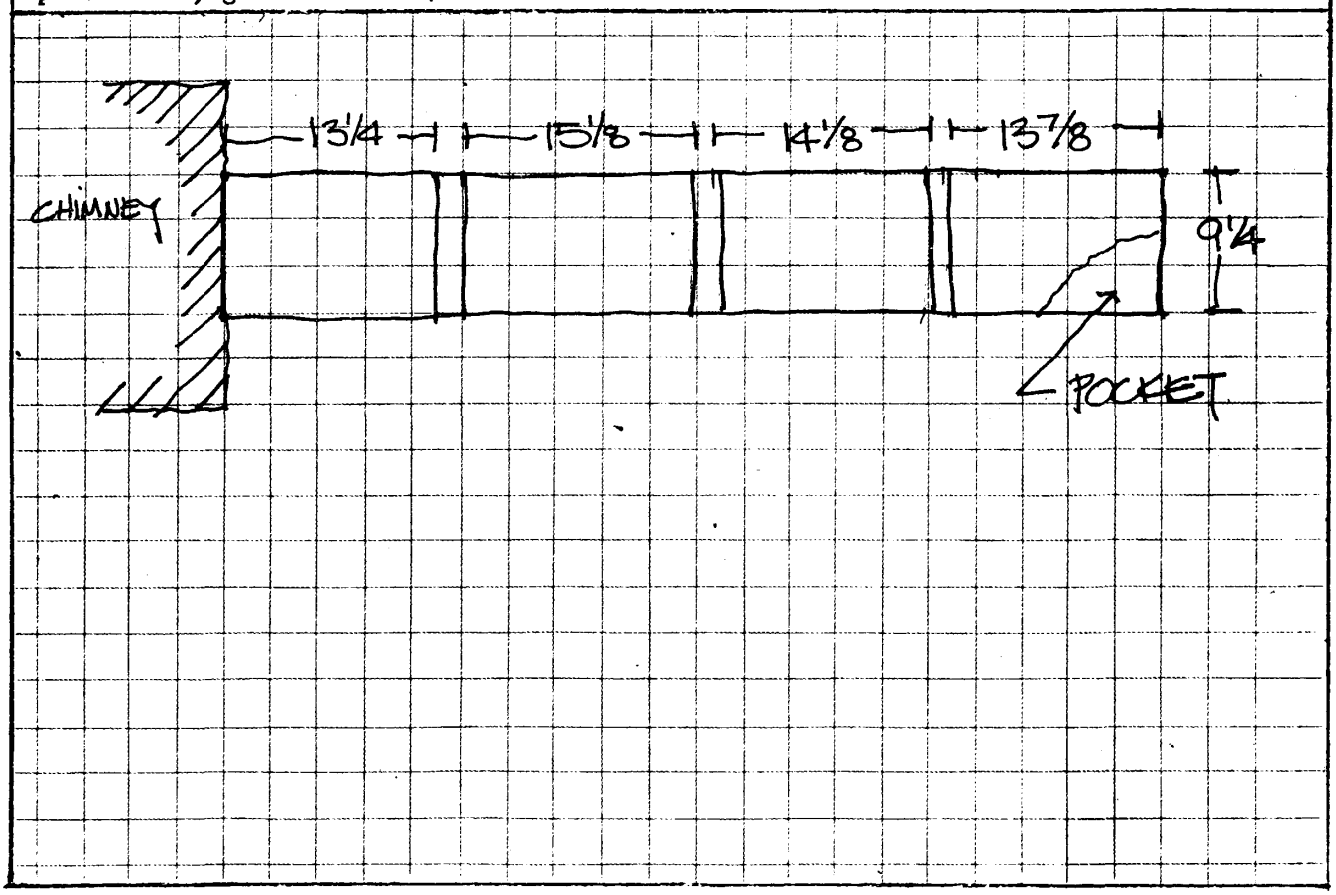
plan location(s) hallway venting 2 10X10 ridge, 2 - 12X12 gable
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type None vapor barrier type none
RETROFIT: insulation type mineral wool vapor barrier type none
retrofit installation procedures/problems floor boards - joists perpendicular to rafters
difficulty of opening/closing sample NONE 1 hour

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS

insulation thickness 4.83" flame no char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 15 WALL
ADDRESS _____ DATE 27 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit 2 house 25 ORIENTATION north
HEAT SYSTEM forced air INSTALLER & DATE Sept 1975

FIELD OBSERVATIONS

plan location(s) bedroom venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type foil on outside
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems foil on outer wall

difficulty of opening/closing sample NONE

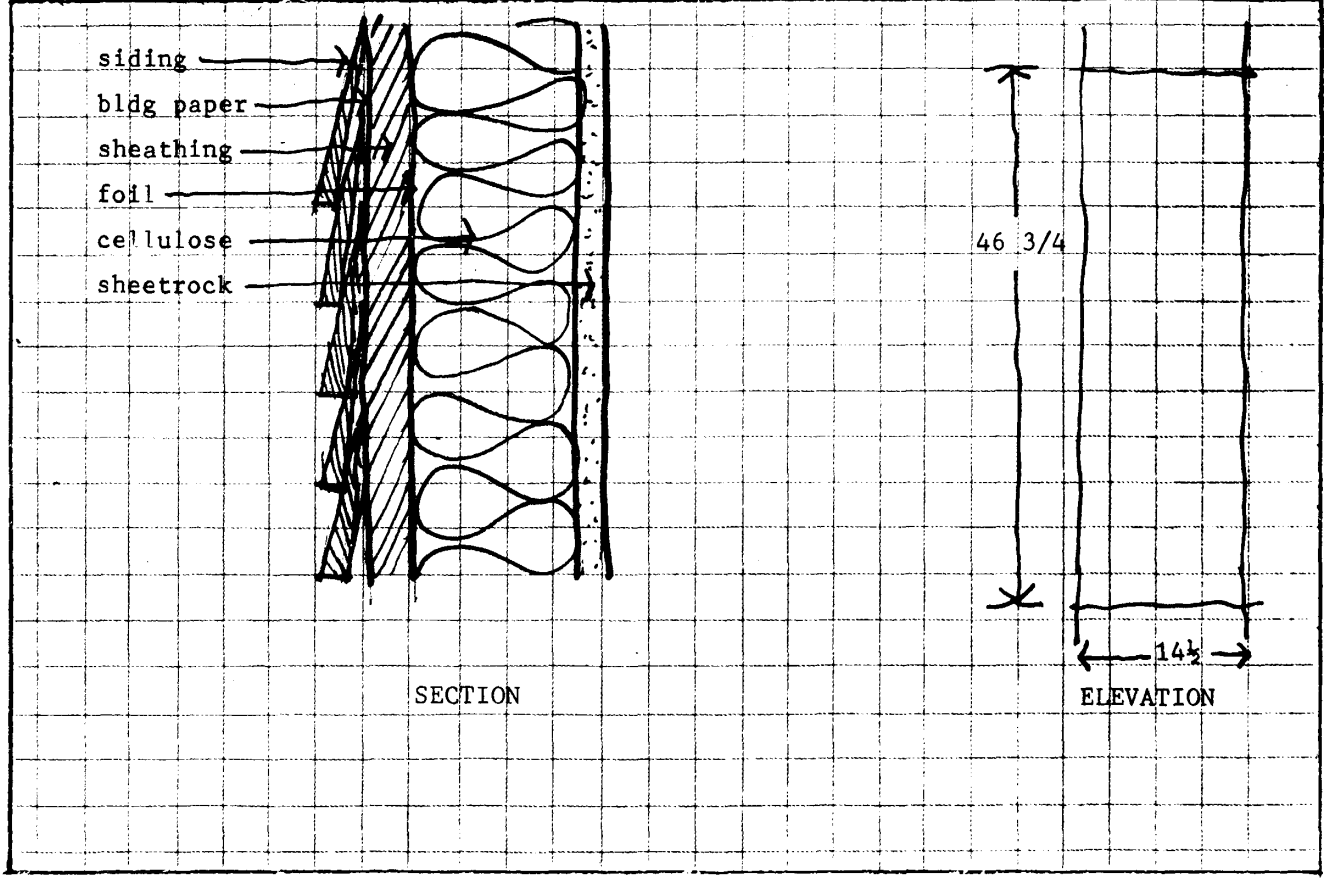
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none

packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier replaced foil

FIELD TESTS

insulation thickness 3.2" flame char - no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 15 a CEILING
ADDRESS _____ DATE 27 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 2 3/4 house 25 ORIENTATION up
HEAT SYSTEM forced air INSTALLER & DATE Oct 1974

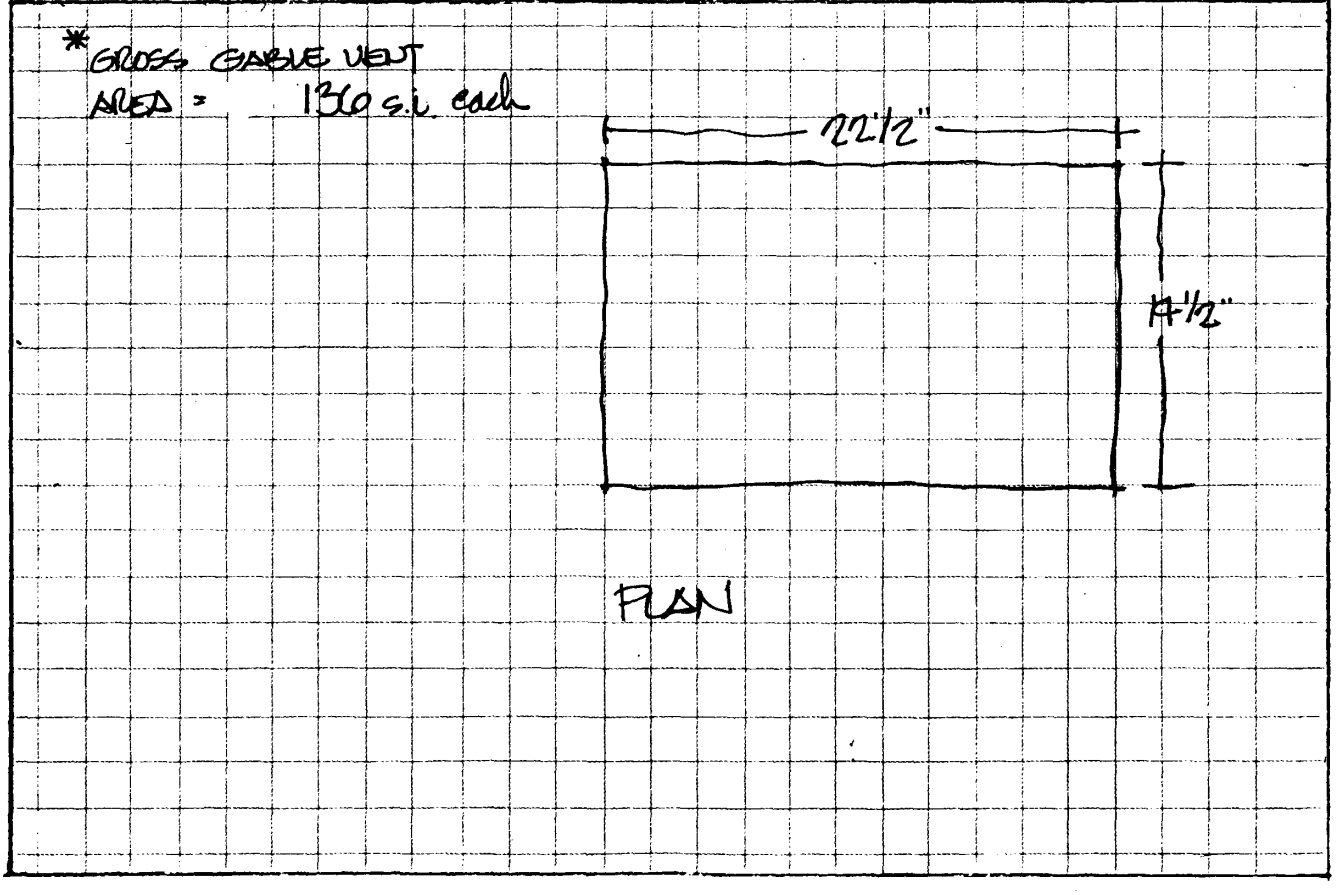
FIELD OBSERVATIONS
plan location(s) living room venting ~~8X16 - 8 ea. + 2 gable vents~~ 50% area *
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood fiber vapor barrier type paper
RETROFIT: insulation type blown wool vapor barrier type NONE
retrofit installation procedures/problems TIGHT SPACE

difficulty of opening/closing sample tight space

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier orig. left in place

FIELD TESTS
insulation thickness 3.68" flame wood chars, no burn
no char/no burn on wool

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 15 b CEILING
ADDRESS _____ DATE 27 July, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 2 house 6 (addition) ORIENTATION up
HEAT SYSTEM forced air INSTALLER & DATE Oct. 1975

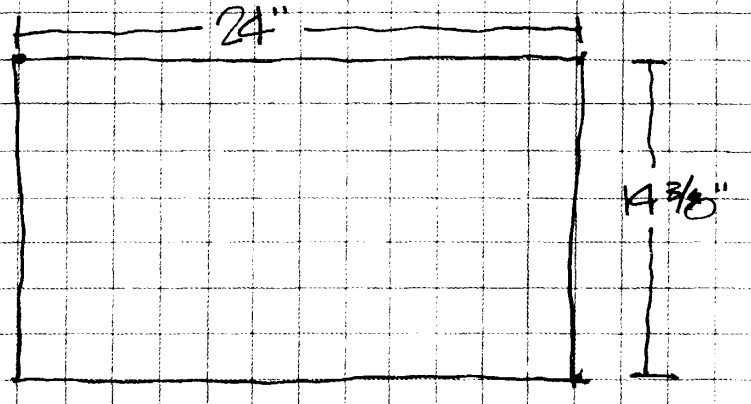
FIELD OBSERVATIONS
plan location(s) family room venting 1 gable open to main attic
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type fiberglass batt vapor barrier type poly
RETROFIT: insulation type fiberglass batt vapor barrier type N/A
retrofit installation procedures/problems tight space

difficulty of opening/closing sample tight space - 2 hours total

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing N/A friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original intact

FIELD TESTS
insulation thickness 7½" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 16 WALL
ADDRESS _____ DATE 27 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit ½ yr house 100 ORIENTATION south
HEAT SYSTEM F.A. INSTALLER & DATE Spring 1977

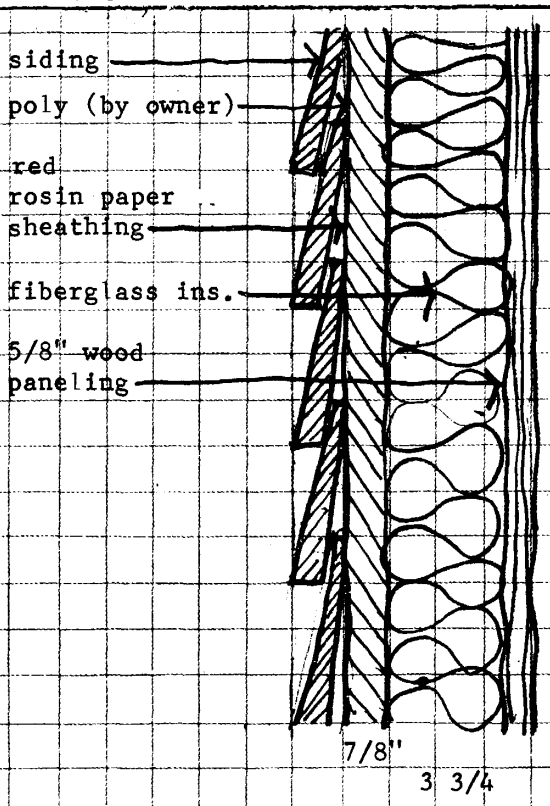
FIELD OBSERVATIONS
plan location(s) storage room venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type NONE vapor barrier type red rosin bldg.
RETROFIT: insulation type blown glass vapor barrier type poly - by owner
retrofit installation procedures/problems firestop

difficulty of opening/closing sample siding fragile - sheathing blindnailed

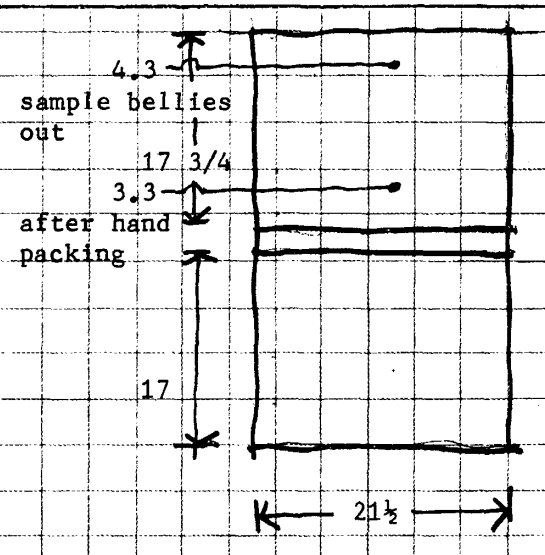
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing medium-not dense friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier re-installed owner's orig.

FIELD TESTS
insulation thickness full cavity flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



ELEVATION

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 16 CEILING
ADDRESS _____ DATE 27 July, 1977
PHONE _____ SOURCE OF LEAD NSP

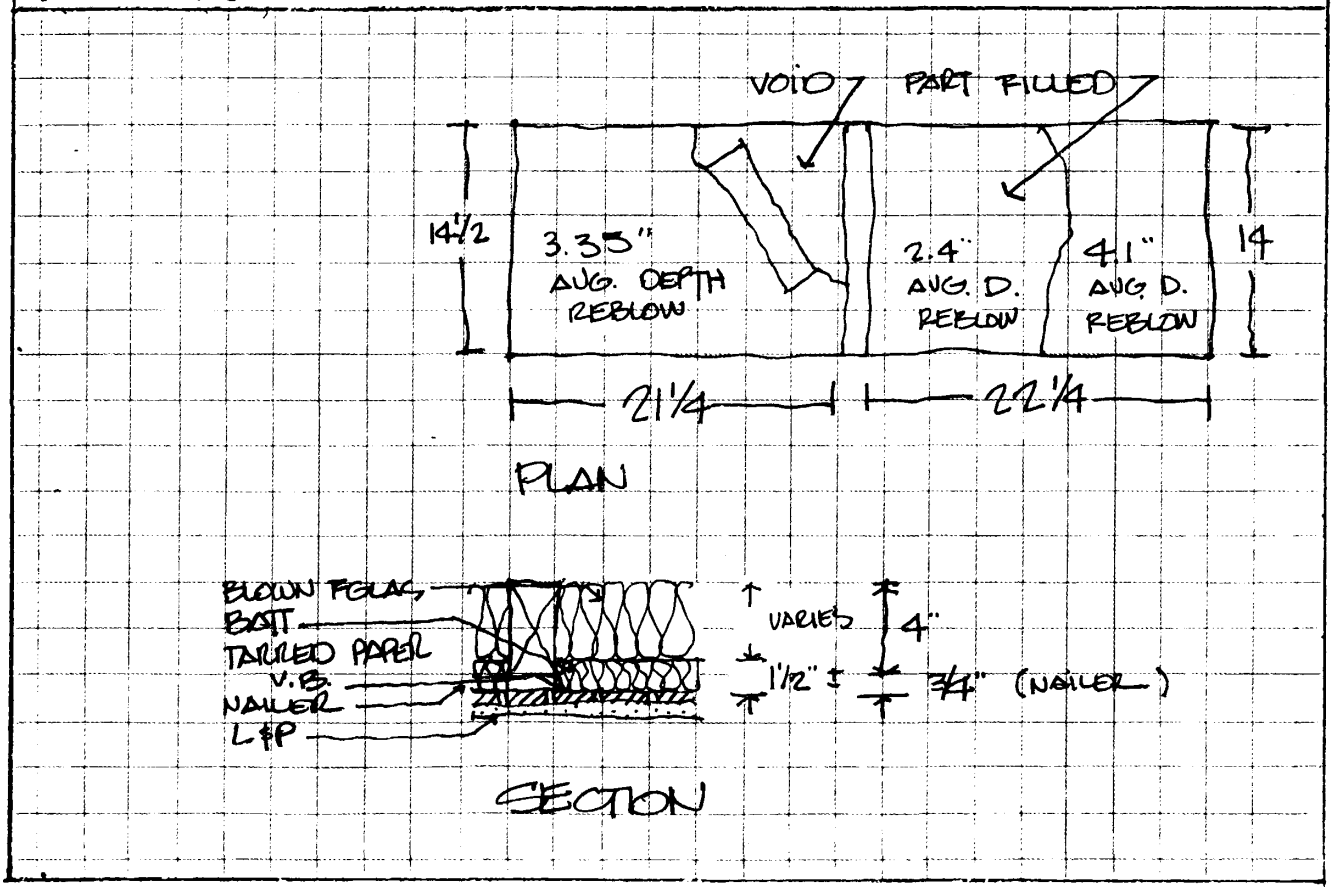
GENERAL
AGE: retrofit ½ yr. house 100 ORIENTATION up
HEAT SYSTEM F.A. INSTALLER & DATE Spring 1977

FIELD OBSERVATIONS
plan location(s) bedroom venting 1 ridge 8X10, no soffit
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type batt vapor barrier type paper
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems numerous trash in cavity, existing batt uneven under floor
difficulty of opening/closing sample floorboards

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing uneven-very dense-v loose friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier orig. re-installed

FIELD TESTS
insulation thickness see below flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 17 WALL
ADDRESS _____ DATE 28 July, 1977
PHONE _____ SOURCE OF LEAD NSP

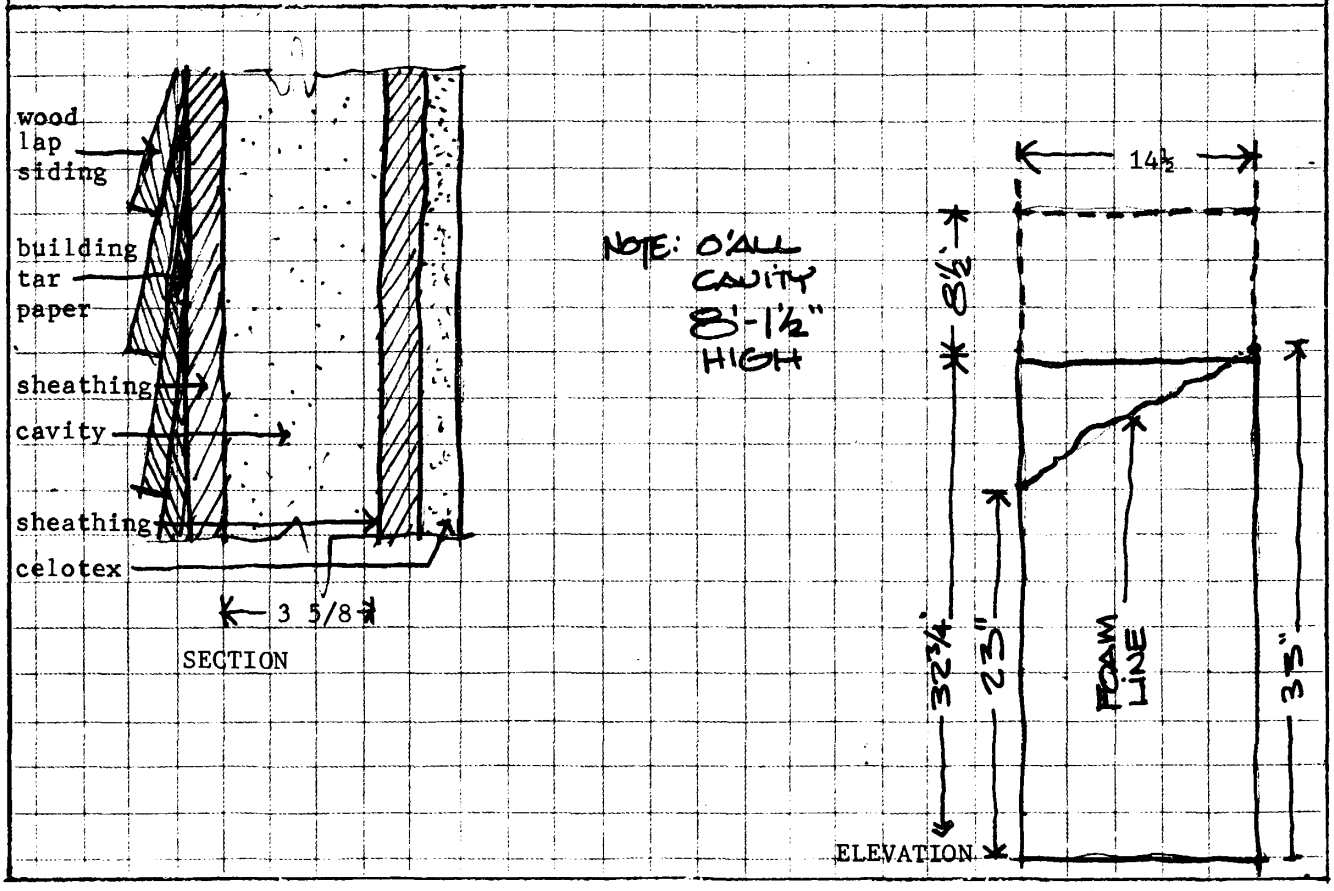
GENERAL
AGE: retrofit 4 house 1941 ORIENTATION south
HEAT SYSTEM forced air INSTALLER & DATE May 1974

FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood shavings vapor barrier type NONE
RETROFIT: insulation type UF vapor barrier type NONE
retrofit installation procedures/problems wood shavings fairly full in cavity - did not allow fill. installation holes @ 7'6" and ± 2'0"
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
dampness lower right - outside bldg paper - rain previous day - interior dry
packing wood shavings packed well friability good
REPLACEMENT: insulation UF vapor barrier NONE

FIELD TESTS
insulation thickness full cavity flame foam chars, no burn - wood burns

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 17 CEILING
ADDRESS _____ DATE 28 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 18 house 36 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE 1958,1959

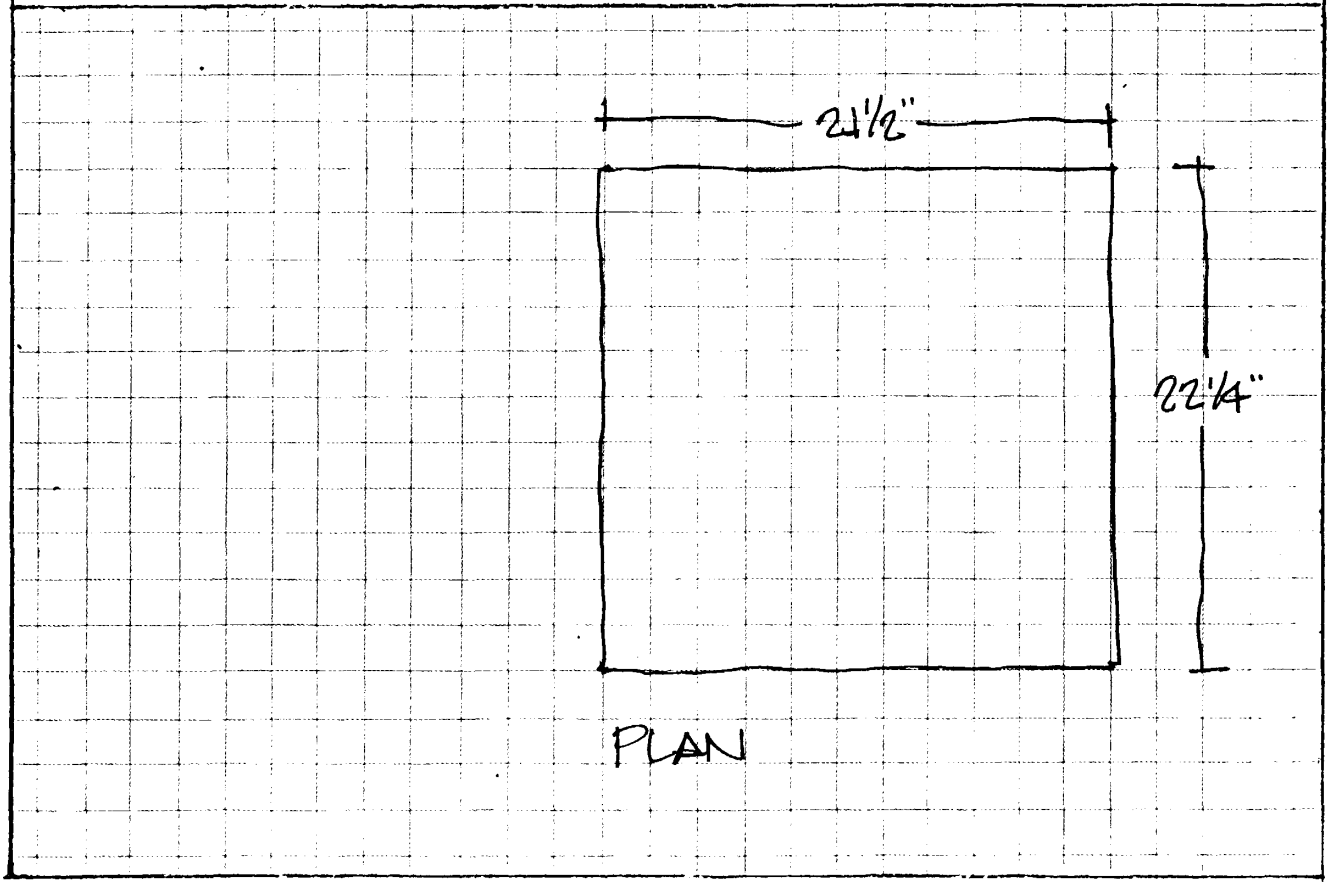
FIELD OBSERVATIONS
plan location(s) living room venting open to attic with gable end - ridge vent
framing type joist/rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood shavings vapor barrier type NONE
RETROFIT: insulation type Cellulose vapor barrier type NONE
retrofit installation procedures/problems NONE

difficulty of opening/closing sample NONE

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE
packing good friability N/A
REPLACEMENT: insulation glass batt vapor barrier NONE

FIELD TESTS
insulation thickness 4.47" flame pour material chars, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 18 WALL
ADDRESS _____ DATE 28 July, 1977
PHONE _____ SOURCE OF LEAD NSP

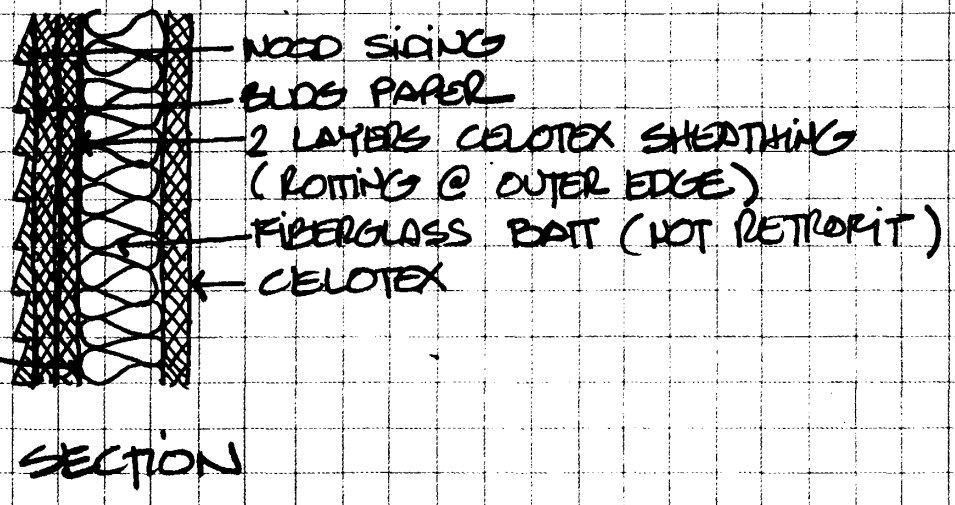
GENERAL
AGE: retrofit .66yr. house 56 yrs. ORIENTATION north
HEAT SYSTEM F.A. INSTALLER & DATE November 1976

FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type 2 X 4 stud condition of structure fair
condition of wiring N/A
ORIGINAL: insulation type fiberglass batt vapor barrier type none
RETROFIT: insulation type None * vapor barrier type none
retrofit installation procedures/problems cavity full - no retrofit could be blown
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
cellutex sheathing rotting - (due to leakage)
packing N/A friability N/A
REPLACEMENT: insulation N/A vapor barrier N/A

FIELD TESTS
insulation thickness cavity full flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION

* fiberglass was to be blown - no sample taken

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 18 CEILING
ADDRESS _____ DATE 28 July, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit .66 yr house 56 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE November 1976

FIELD OBSERVATIONS
plan location(s) living room venting gables - 1 roof complex
framing type joist & rafter condition of structure excellent
condition of wiring N/A . open
ORIGINAL: insulation type 2 faced batt vapor barrier type tar paper - joints
RETROFIT: insulation type blown glass vapor barrier type NONE
retrofit installation procedures/problems NONE

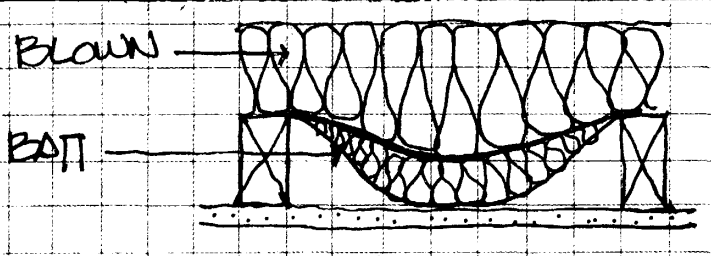
difficulty of opening/closing sample NONE

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
NONE

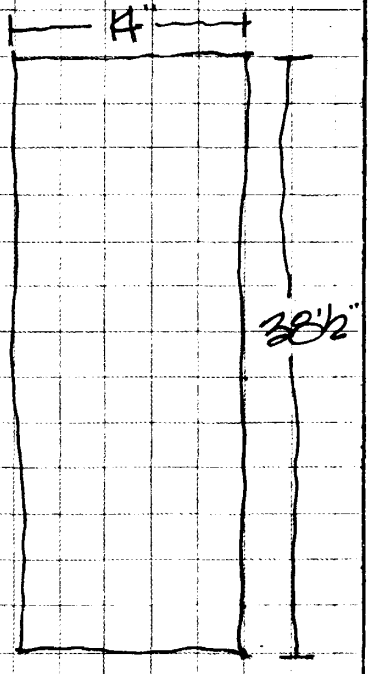
packing good friability N/A
REPLACEMENT: insulation glass batt vapor barrier NONE

FIELD TESTS
insulation thickness 7½" flame both char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 19 CEILING
ADDRESS _____ DATE 5 August 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 yrs. house 25-30 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE 6/7/74

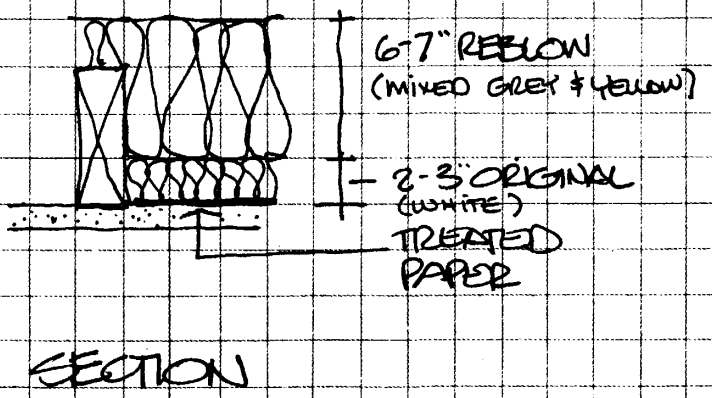
FIELD OBSERVATIONS
plan location(s) dining area venting PRV + 2 10x10 gables
framing type rafter & joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type mineral vapor barrier type paper-discont.
RETROFIT: insulation type mineral vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

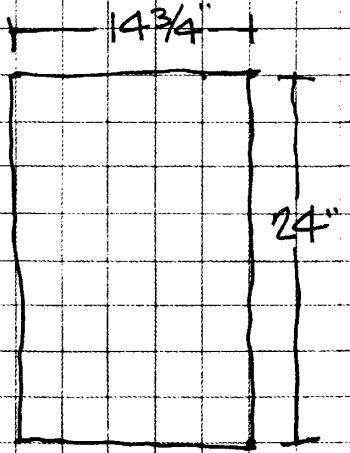
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation f glass vapor barrier original left intact

FIELD TESTS
insulation thickness 9½ + flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

NOTE: Label says 6" installed
Eave vents appear blocked

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 20 CEILING
ADDRESS _____ DATE 5 August 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 3.2 house 22 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE 6/27/74

FIELD OBSERVATIONS

plan location(s) bedroom venting 2 gables *
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wool vapor barrier type paper- discont.
RETROFIT: insulation type glass vapor barrier type N/A
retrofit installation procedures/problems none

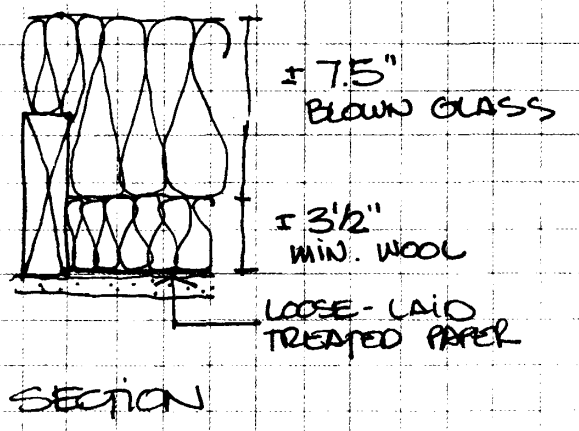
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation f glass batt vapor barrier ___ orig. left in place

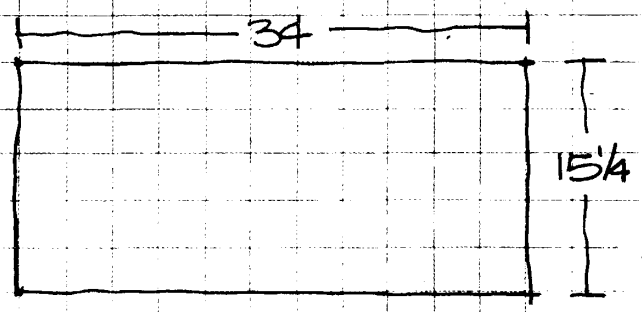
FIELD TESTS

insulation thickness see below flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

NOTE: Label 4"

* gables 14"x36" less louvers
possible one soffit also (6x10x2")

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 21 CEILING
ADDRESS _____ DATE 5 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 17 ORIENTATION N/A
HEAT SYSTEM F.A. INSTALLER & DATE September 1975

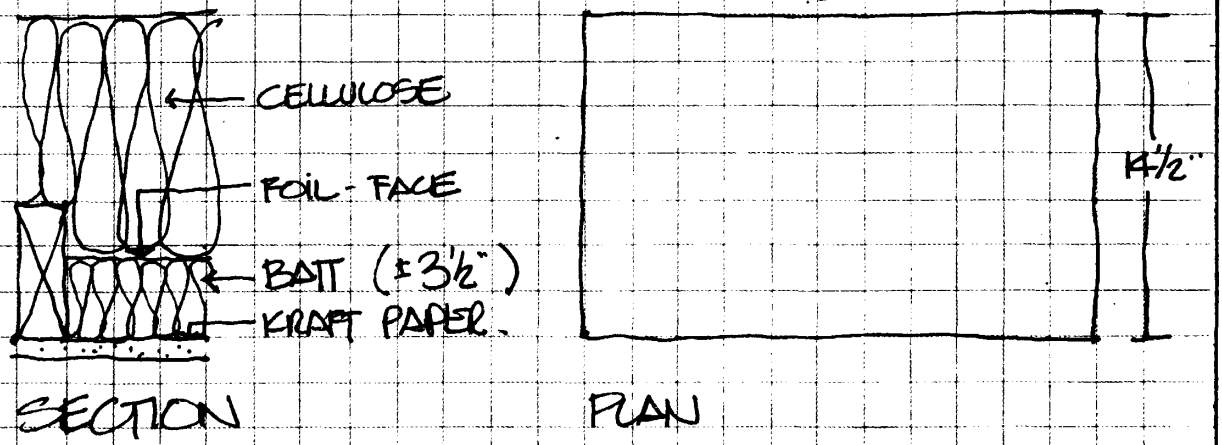
FIELD OBSERVATIONS
plan location(s) bedroom venting 2 gable & 2 ridge *
framing type joist & rafter condition of structure excellent
condition of wiring appears good
ORIGINAL: insulation type foil faced batt vapor barrier type foil
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems tight space - uneven but deep

difficulty of opening/closing sample tight space

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass vapor barrier left original batt in place

FIELD TESTS
insulation thickness 10.13" cellulose flame chars - self extinguishing

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: Labeled R-22

* Gables 144 s.i. each less louvers
Ridge 72 s.i. each less screens

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 22 CEILING
ADDRESS _____ DATE 5 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 14 house 15 ORIENTATION N/A
HEAT SYSTEM electric F.A. INSTALLER & DATE 1963

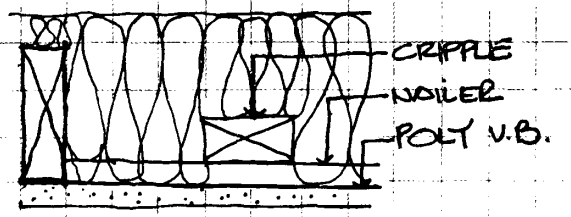
FIELD OBSERVATIONS
plan location(s) stairway venting 3 gable vents - see below
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type poly
RETROFIT: insulation type blown vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

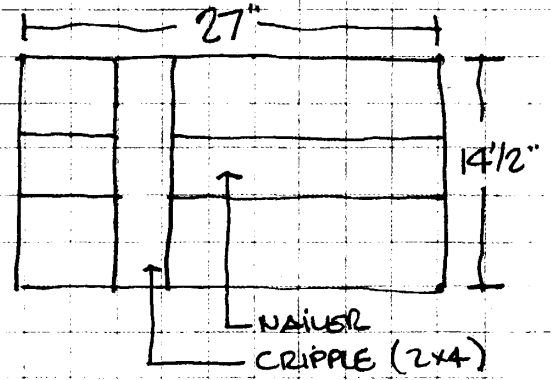
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation Fglass batt vapor barrier original intact

FIELD TESTS
insulation thickness 7.35" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

NOTE: Original depth 10" - CONTRACT

gable vents - 3 each 12 X 24
soffit vents - 2" dia 22 each

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 23 WALL
ADDRESS _____ DATE 17 August 1977
PHONE _____ SOURCE OF LEAD volunteer

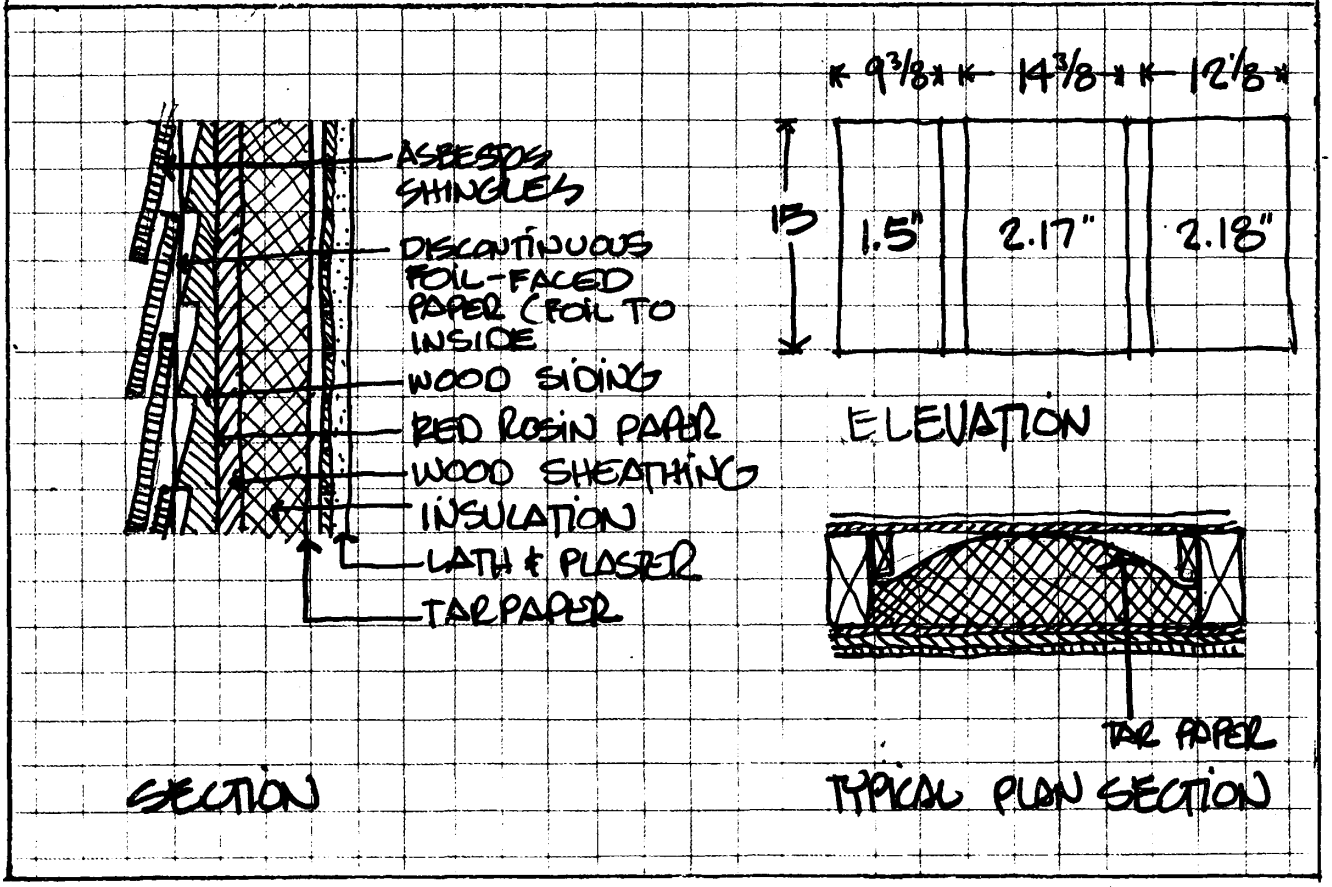
GENERAL
AGE: retrofit 1 1/3 house 71 ORIENTATION North
HEAT SYSTEM gas H.W. INSTALLER & DATE May '76

FIELD OBSERVATIONS
plan location(s) kitchen venting N/A
framing type 2X4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems barrier

difficulty of opening/closing sample asbestos shingles very difficult to remove without damage
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS
insulation thickness 1.95 flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 23 CEILING
ADDRESS _____ DATE 17 August 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit 1.75 house 65 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE Feb. 1976

FIELD OBSERVATIONS

plan location(s) hall venting 2 gables 15X24 louvered
framing type rafter & joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems none

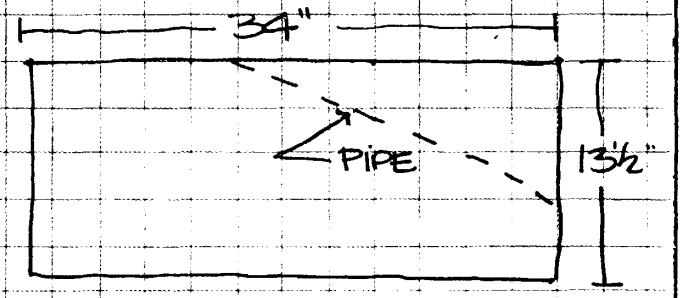
difficulty of opening/closing sample big dog

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS

insulation thickness 6" flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 24 WALL
ADDRESS _____ DATE 17 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1.2 house 85 ORIENTATION north
HEAT SYSTEM gas H.W. INSTALLER & DATE July '76

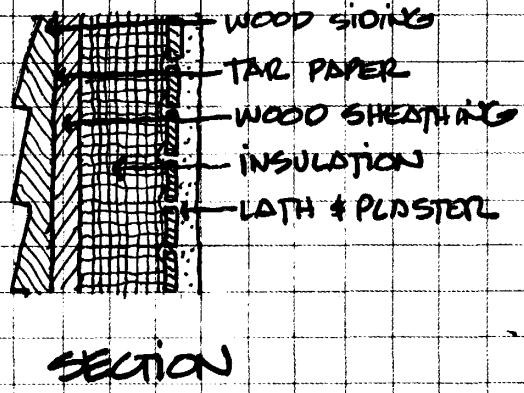
FIELD OBSERVATIONS
plan location(s) dining room venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems backplaster in certain areas

difficulty of opening/closing sample none

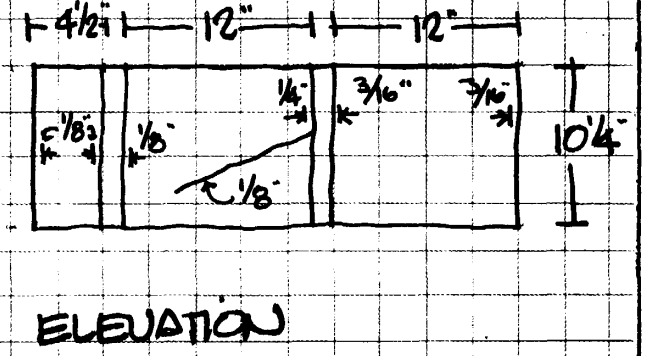
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability good
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS
insulation thickness 3.4" flame N/A

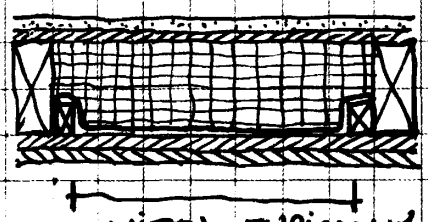
SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



ELEVATION



PLAN SECTION

SHRINKAGE = 4%

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 24 CEILING
ADDRESS _____ DATE 17 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1.2 house 85 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE Sept '76

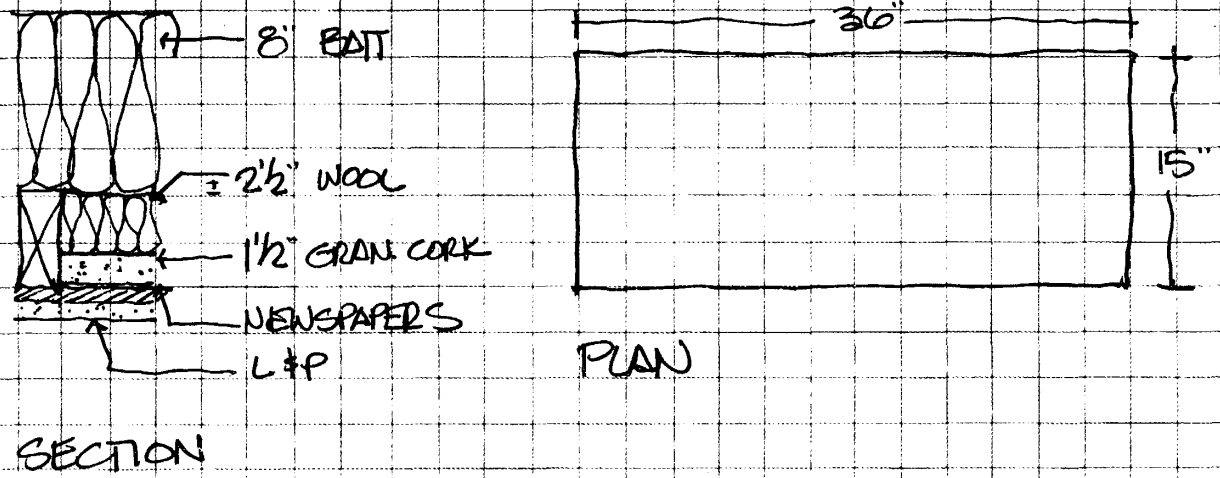
FIELD OBSERVATIONS
plan location(s) living room venting 3 ridge, 1 gable
framing type joist/rafter condition of structure excellent
condition of wiring good
ORIGINAL: insulation type cork/mineral wool vapor barrier type none
RETROFIT: insulation type fiberglass batt vapor barrier type none
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 25 WALL
ADDRESS _____ DATE 17 August 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 2.6 house 50 ORIENTATION west
HEAT SYSTEM gas H.W. INSTALLER & DATE Feb '75

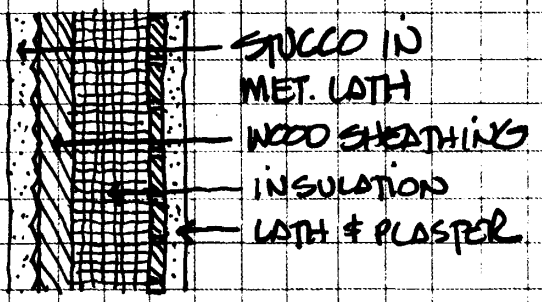
FIELD OBSERVATIONS
plan location(s) living room venting N/A
framing type stud 2X4 condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems none

difficulty of opening/closing sample difficult to get through stucco

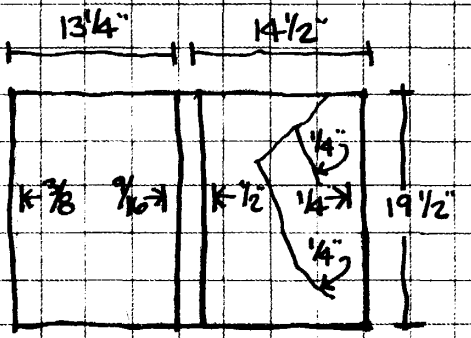
PRESENCE OF: moisture, corrosion, odor, vermin, fungus possible corrosion at sheathing nails (see photo 9) sheathing wet at corner due to downspout removal *
packing N/A friability rather friable
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS
insulation thickness 2.96 flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



* foam appeared to have different friability/density inner sfc to outer sfc; some yellow discoloration on exterior face near leakage corner.

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

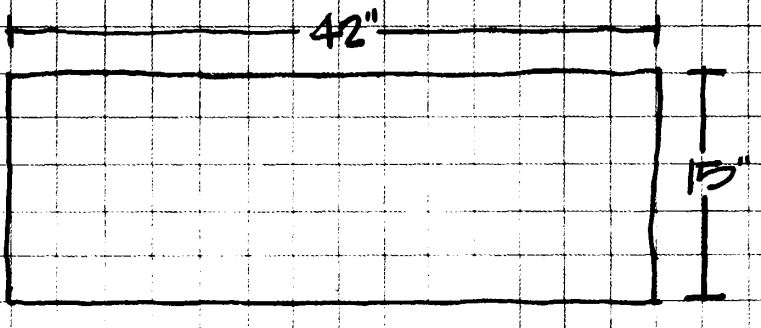
NAME _____ SAMPLE NO. 25 CEILING
ADDRESS _____ DATE 17 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 2½ house 50 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE Feb 1, 1975

FIELD OBSERVATIONS
plan location(s) bedroom venting 1 gable very small free area (perf alum.)
framing type rafter/joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type fiberglass batt vapor barrier type none
retrofit installation procedures/problems none - attic hot - ventilation minimal
difficulty of opening/closing sample none
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
some sign of moisture stain @ ridge - may be old leakage
packing N/A friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 6" flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



PLAN

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 26 WALL
ADDRESS _____ DATE 22 August 1977
PHONE _____ SOURCE OF LEAD _____ VOL.

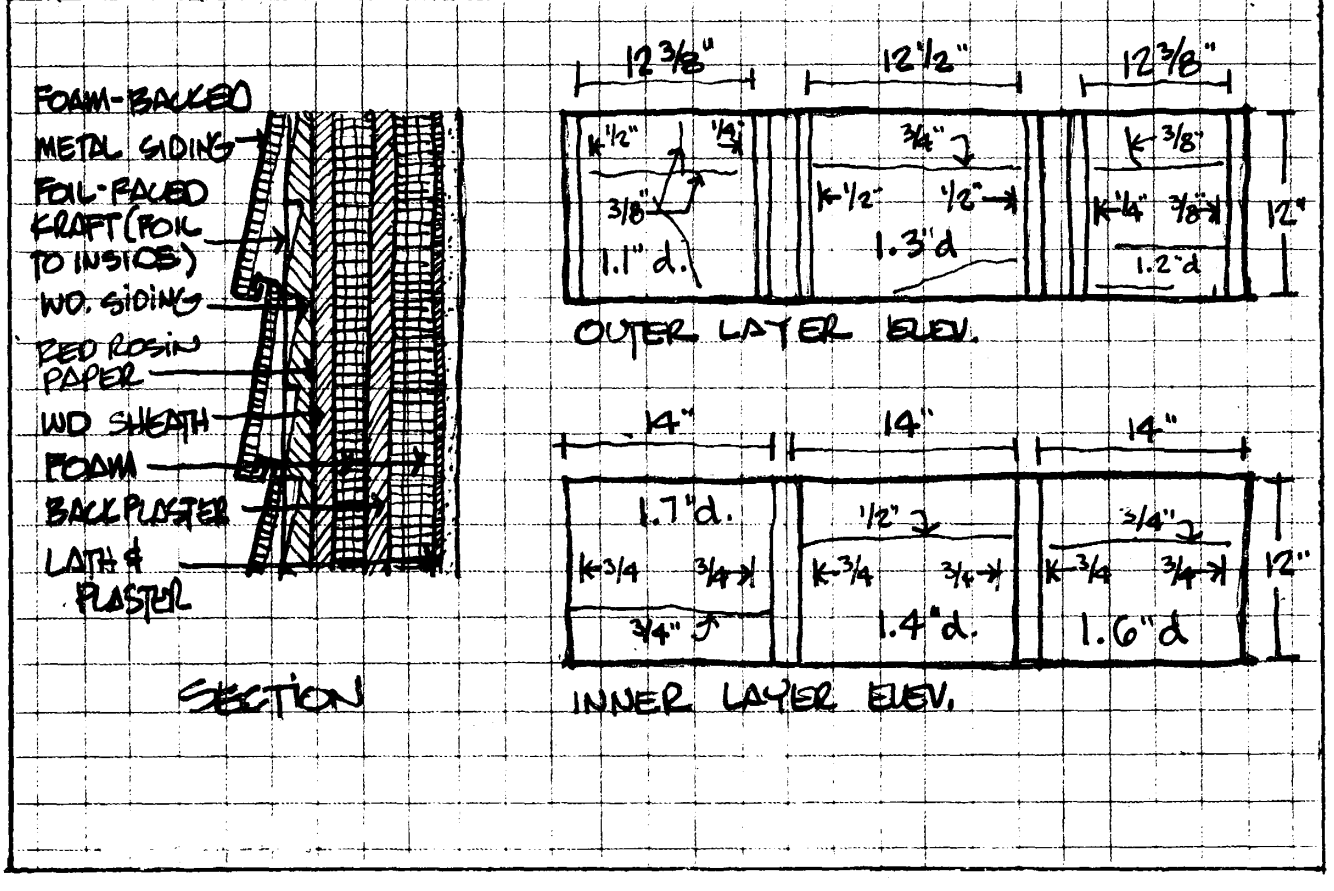
GENERAL
AGE: retrofit 1.5 house 78 yrs ORIENTATION East
HEAT SYSTEM gas H.W. INSTALLER & DATE March 1976

FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type 2X4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems backplaster

difficulty of opening/closing sample aluminum siding, backplaster - several layers - 2 hours
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability outer layer friable, inner rather intact
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS
insulation thickness see below flame char, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 26 CEILING
ADDRESS _____ DATE 22 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

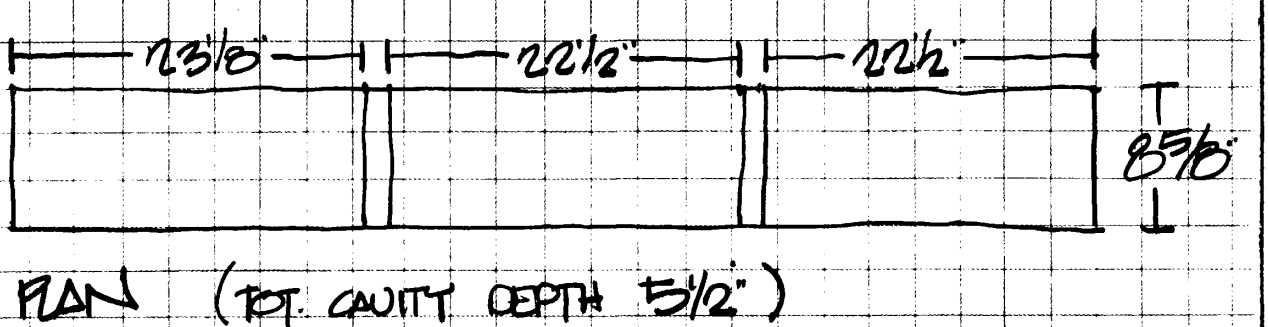
GENERAL
AGE: retrofit 1½ house 78 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE March 1976

FIELD OBSERVATIONS
plan location(s) entry venting N/A
framing type rafter/joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems uneveness - problem due to blowby from loose floorboards
difficulty of opening/closing sample floorboards

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing O.K. friability N/A
REPLACEMENT: insulation cellulose vapor barrier none

FIELD TESTS
insulation thickness 4.5" flame chars, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



PLAN (TOT. CAVITY DEPTH 5 1/2")

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 27 WALL
ADDRESS _____ DATE 22 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 1 house 75+ ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE Sept 1976

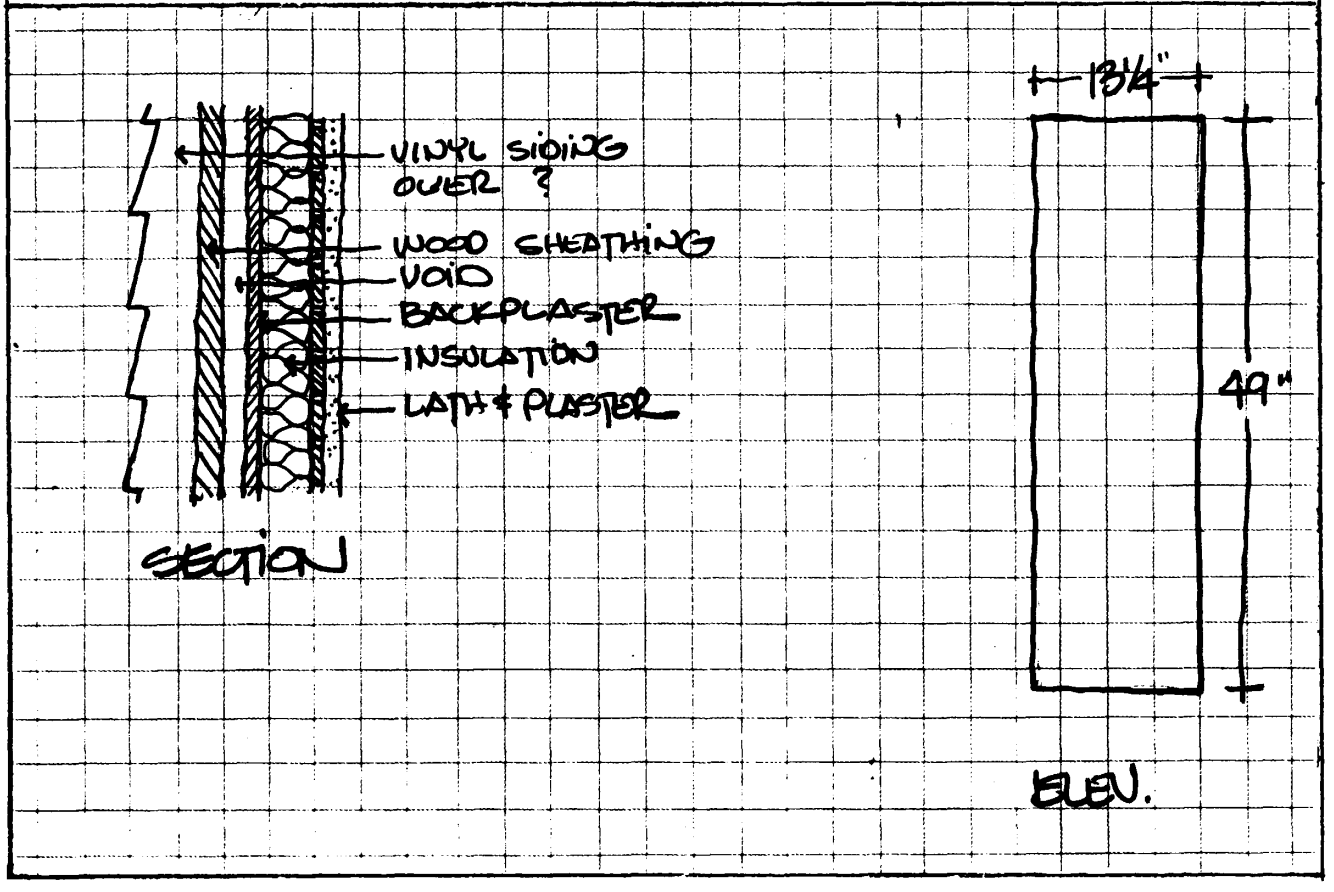
FIELD OBSERVATIONS
plan location(s) dining venting N/A
framing type balloon - stops @ floor condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems backplaster

difficulty of opening/closing sample sawing through lath and plaster

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS
insulation thickness 2.2" flame chars, self extinguising

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 27 CEILING
ADDRESS _____ DATE 22 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

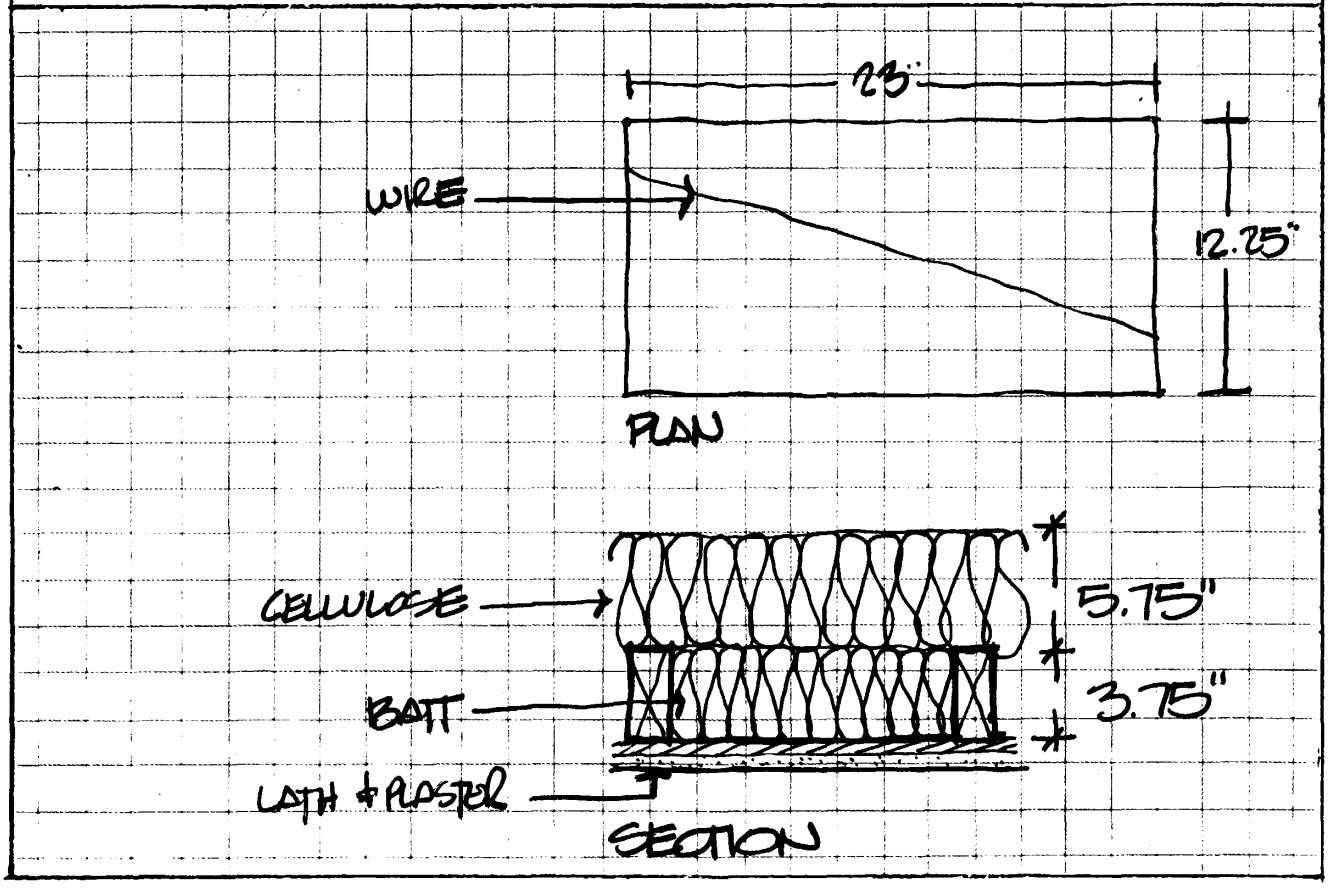
GENERAL
AGE: retrofit 1 house 75 + ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE September 76

FIELD OBSERVATIONS
plan location(s) hallway venting 2 gables end + 18x24 each
framing type rafter/joist condition of structure good
condition of wiring good
ORIGINAL: insulation type mineral batt vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems none

difficulty of opening/closing sample deep insulation - could not move around attic - debris in bottom of cavity
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass vapor barrier none

FIELD TESTS
insulation thickness _____ ~~see below~~ - flame chars - self extinguishing

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 28 CEILING
ADDRESS _____ DATE 24 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 2 house 18 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 1975

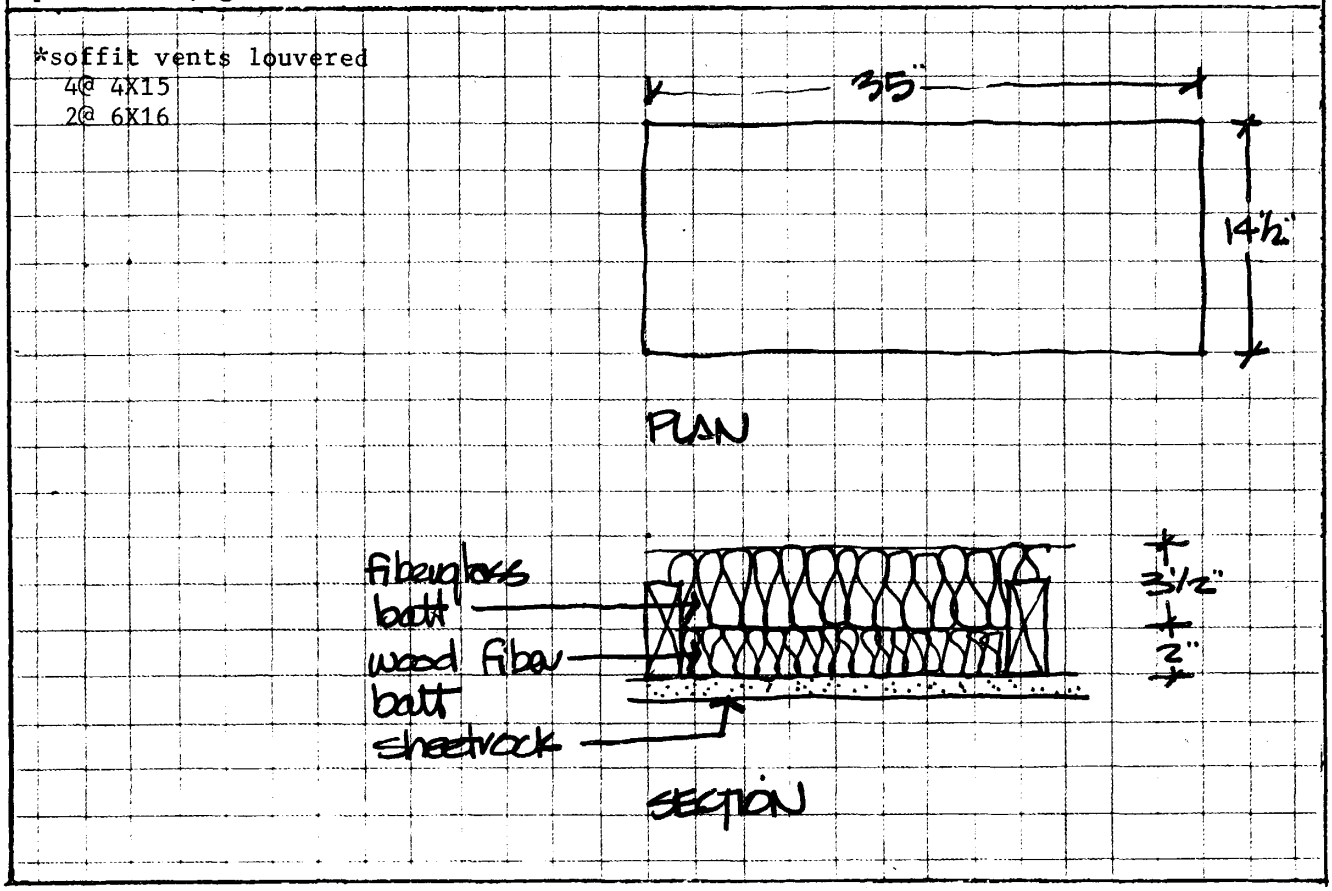
FIELD OBSERVATIONS
plan location(s) kitchen venting 2, 9" ridge, 1 PRV, soffit vents *
framing type raft & joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood fiber batt vapor barrier type none
RETROFIT: insulation type fiberglass batt vapor barrier type none
retrofit installation procedures/problems tight space

difficulty of opening/closing sample tight space

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness see below flame chars, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 29 CEILING
ADDRESS _____ DATE 24 August, 1977
PHONE _____ SOURCE OF LEAD NSP

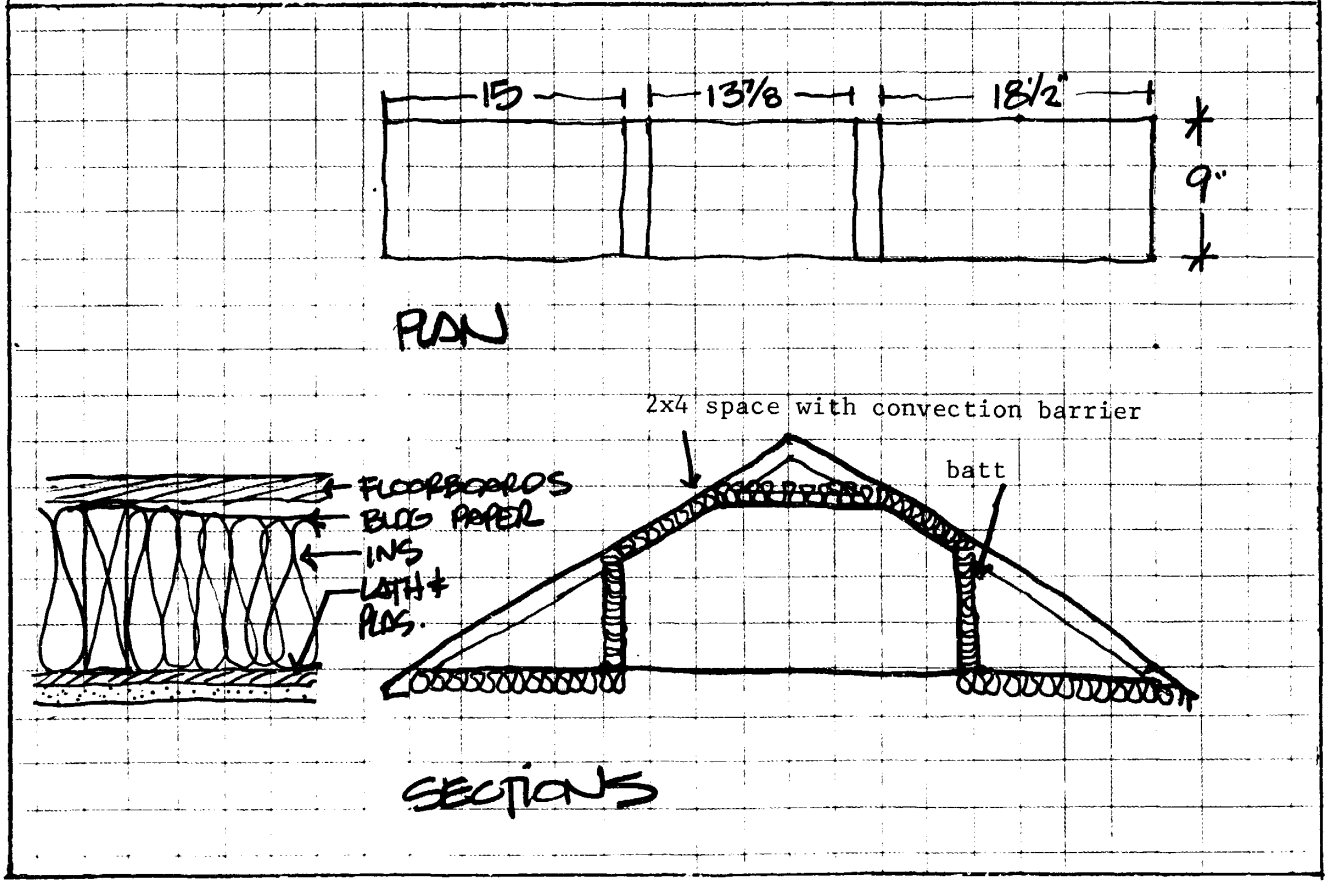
GENERAL
AGE: retrofit 1 house 54 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE July '76

FIELD OBSERVATIONS
plan location(s) bedroom venting 2, 9" dia. roof vents per gable
framing type joist & rafter condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type blown glass vapor barrier type none
retrofit installation procedures/problems floor boards, varied structural type, shallow roof rafters
difficulty of opening/closing sample floor boards - long

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing O.K. friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 7¼" flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 30 CEILING
ADDRESS _____ DATE 24 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 yrs house 12 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE March 4, 1975

FIELD OBSERVATIONS
plan location(s) bedroom venting ridge vents, soffit vents
framing type trusses condition of structure excellent
condition of wiring good
ORIGINAL: insulation type mineral wool vapor barrier type treated paper
RETROFIT: insulation type fiberglass blown vapor barrier type N/A
retrofit installation procedures/problems none

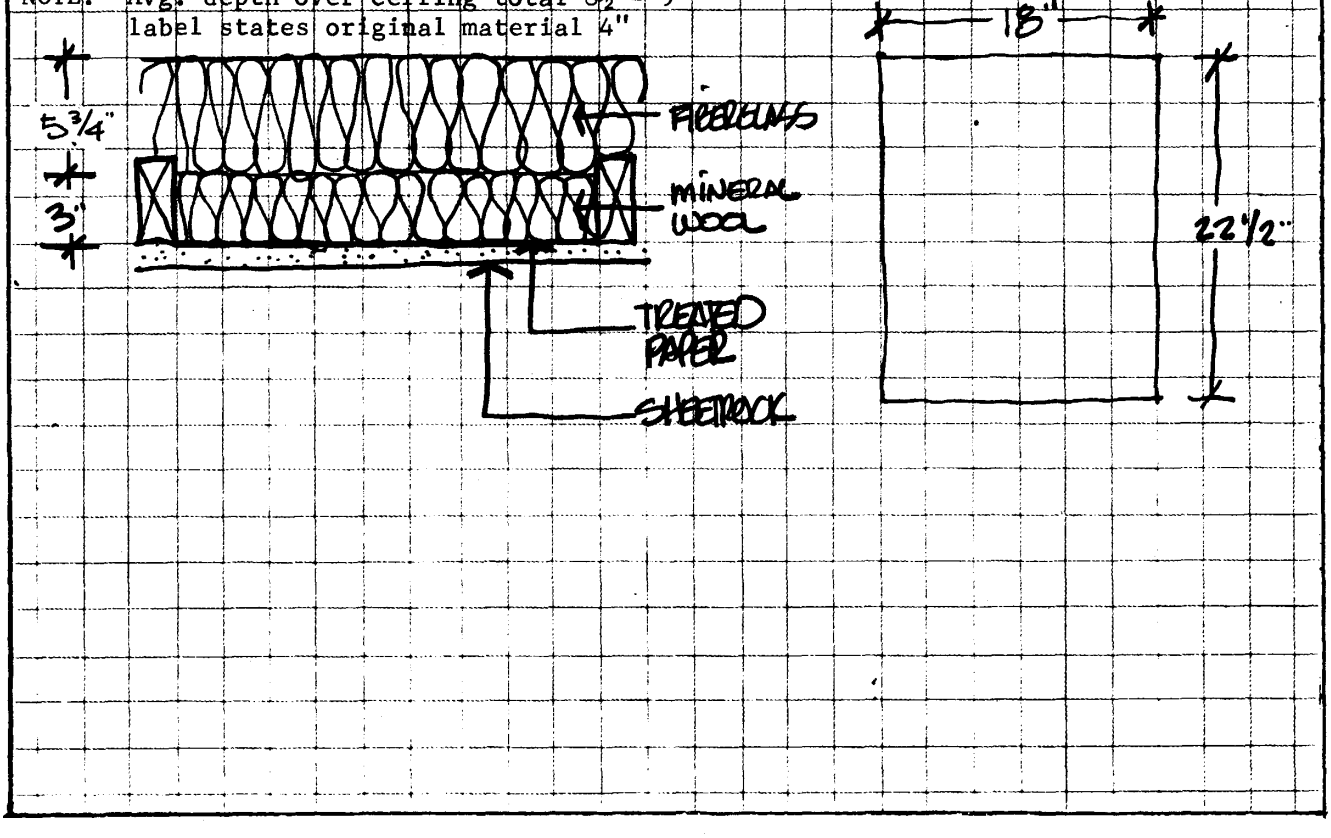
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing moderate friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier N/A

FIELD TESTS
insulation thickness 8 3/4" * flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)

NOTE: Avg. depth over ceiling total 8½ - 9"
label states original material 4"



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 31 CEILING
ADDRESS _____ DATE 24 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 3 yrs house 20 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE Aug 20, 1974

FIELD OBSERVATIONS

plan location(s) bedroom venting 4 ridge 8" dia - soffit vents
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type batt/blown glass vapor barrier type kraft - tarred
RETROFIT: insulation type blown wool vapor barrier type N/A
retrofit installation procedures/problems none

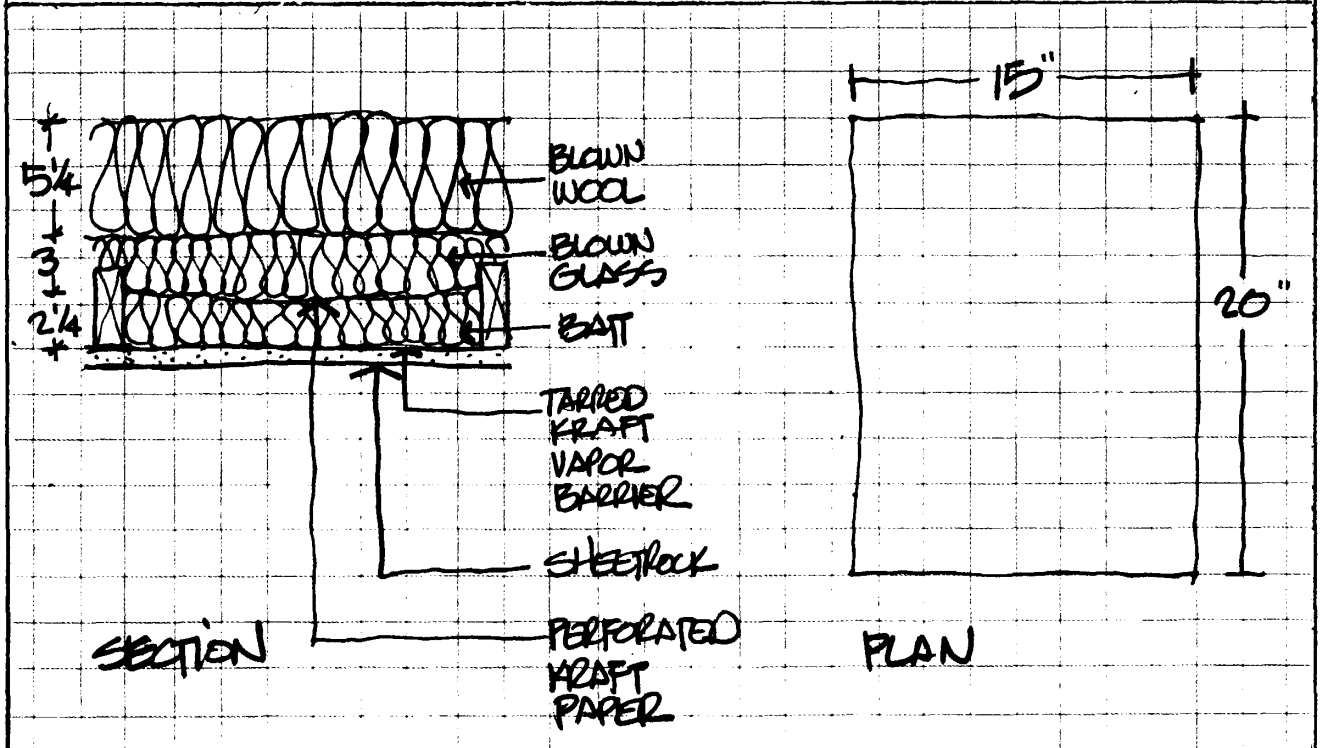
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none - attic hot
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left in place

FIELD TESTS

insulation thickness 10½" total flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



Label: August 1974

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 32 CEILING
ADDRESS _____ DATE 24 August, 1977
PHONE _____ SOURCE OF LEAD _____ VOL.

GENERAL
AGE: retrofit 2 mos house 30 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE July 1, 1977

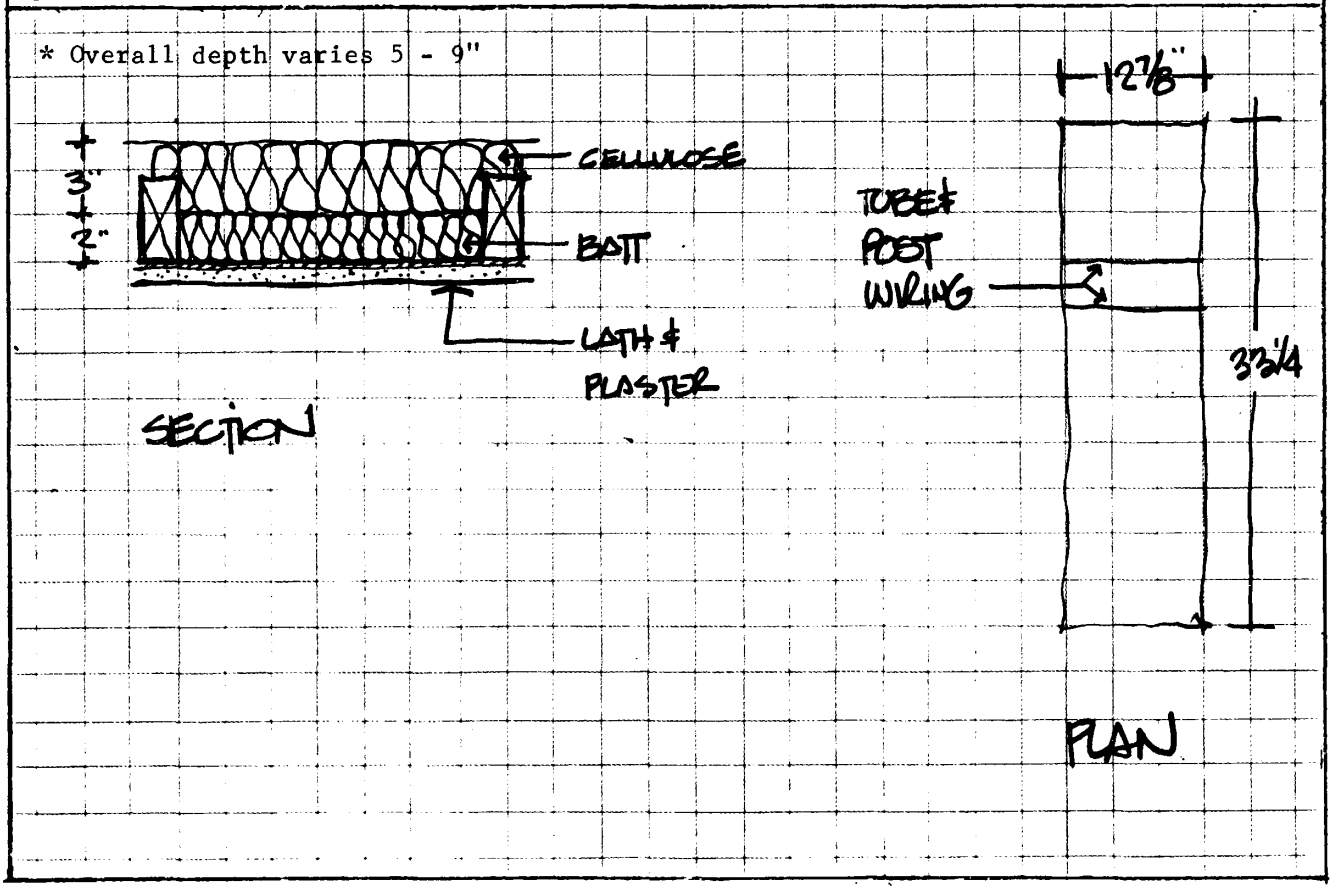
FIELD OBSERVATIONS
plan location(s) hall venting gable ends - 8 vents coming
framing type joist & rafter condition of structure good
condition of wiring good
ORIGINAL: insulation type batt vapor barrier type kraft/tarred
RETROFIT: insulation type cellulose vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing moderate friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original in tact

FIELD TESTS
insulation thickness 5" * flame burns

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 33 CEILING
ADDRESS _____ DATE 25 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2.25 house 22 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE June 12, 1975

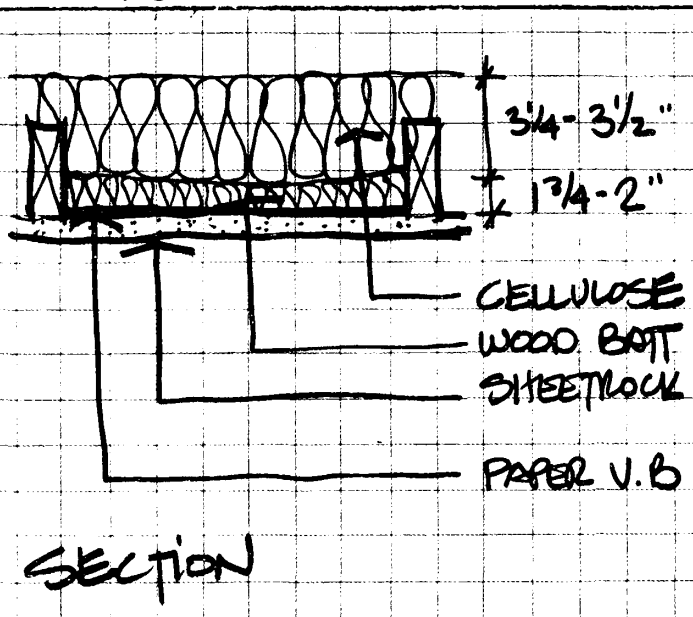
FIELD OBSERVATIONS
plan location(s) living room venting 2 gable vents, 2, 8" dia ridge
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood fiber batt vapor barrier type tarred kraft paper
RETROFIT: insulation type cellulose vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

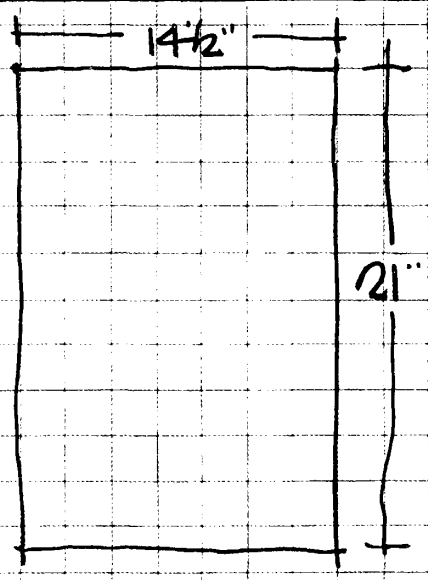
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original in place

FIELD TESTS
insulation thickness 5½" flame chars - self extinguishing

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

NOTE: Sample area shallow. Average depth ± 6"

2" batt compressed to 1 3/4"

Multi-layered batt

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 34 CEILING
ADDRESS _____ DATE 25 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 9 house 11 ORIENTATION N/A
HEAT SYSTEM electric INSTALLER & DATE Sept 1968

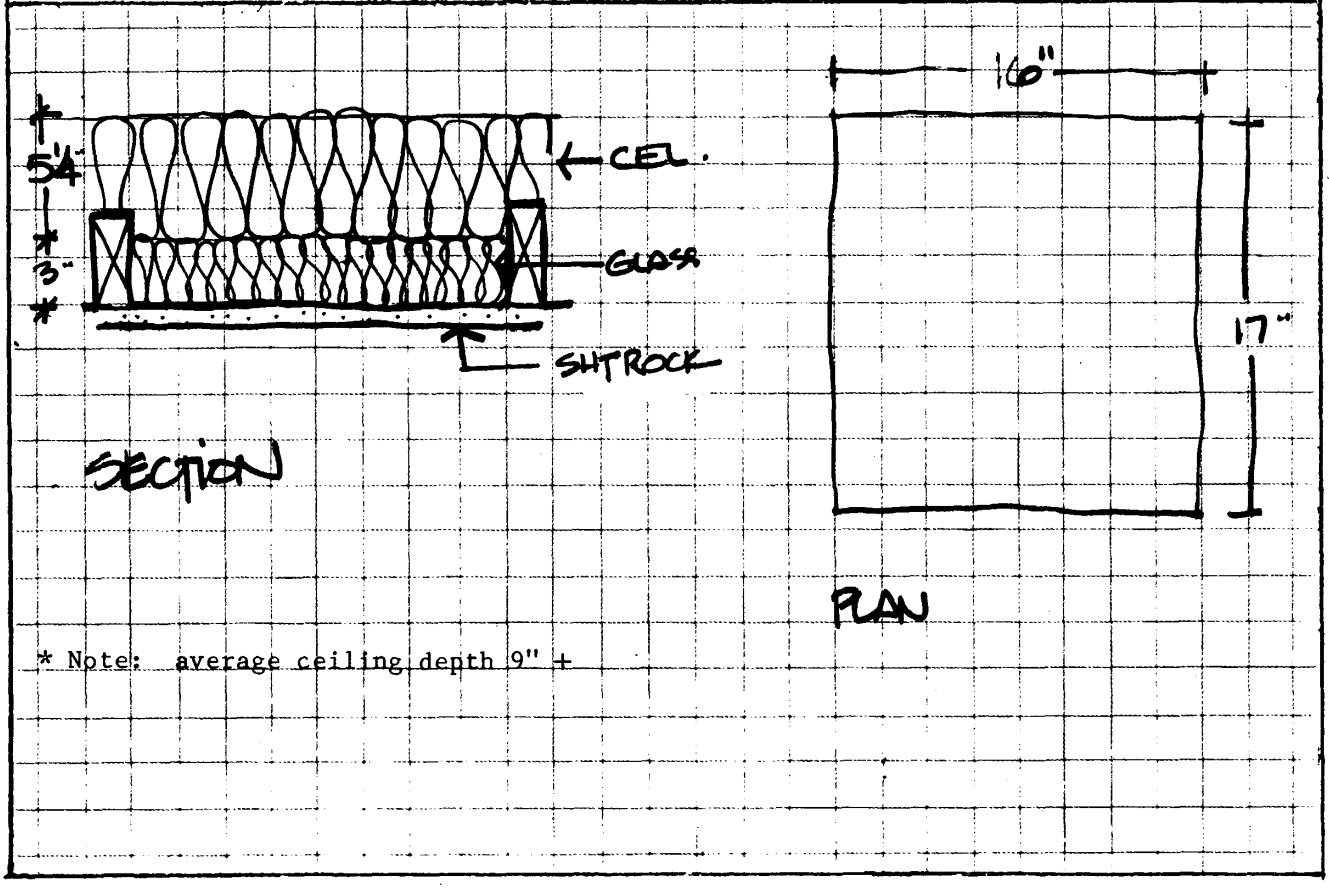
FIELD OBSERVATIONS 4 ridge vents
plan location(s) bedroom venting 4 roof & soffit
framing type trusses condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type fiberglass blown vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



* Note: average ceiling depth 9" +

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 35 CEILING
ADDRESS _____ DATE 25 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 21 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE June '75

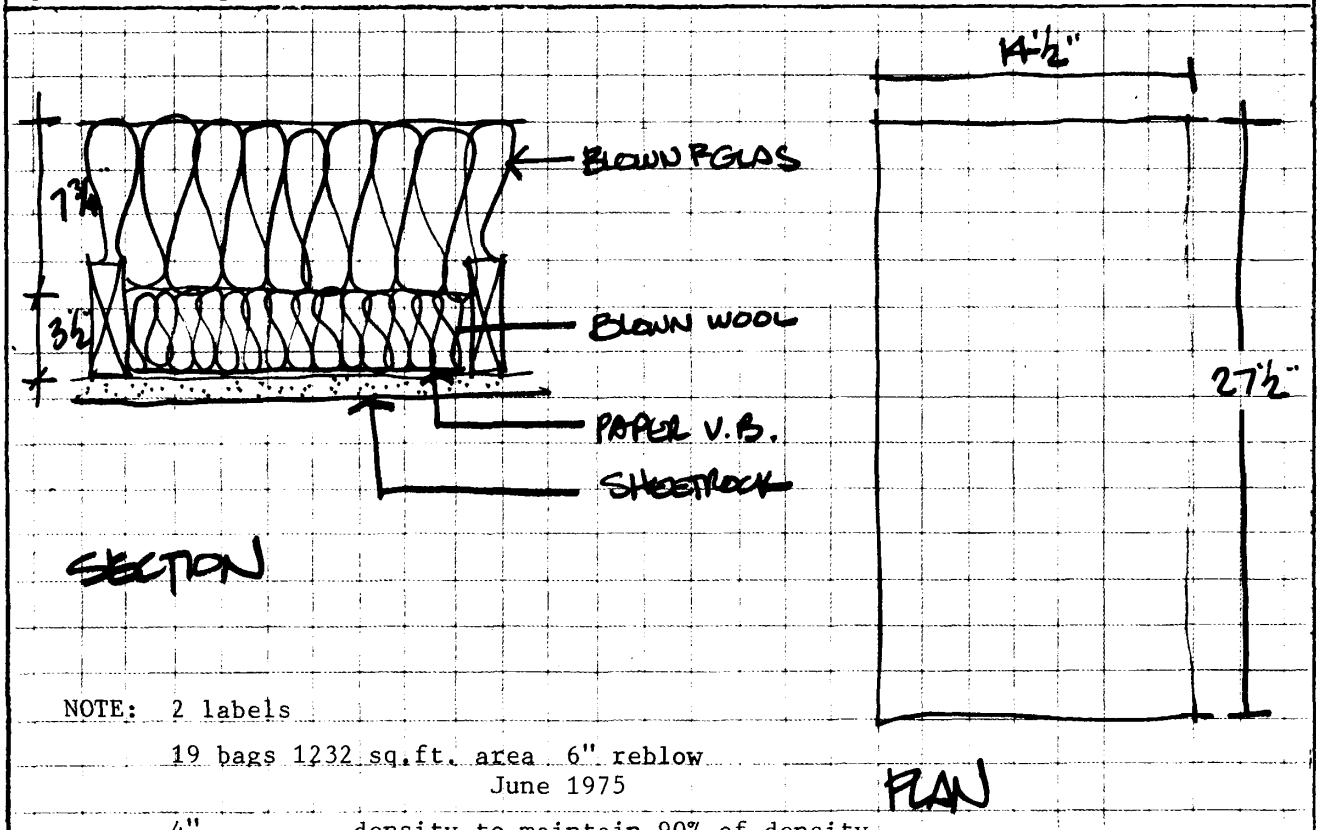
FIELD OBSERVATIONS
plan location(s) dining venting minimal
framing type rafter & joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type mineral wool vapor barrier type disc. treated paper
RETROFIT: insulation type blown fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: 2 labels

19 bags 1232 sq.ft. area 6" reblow
June 1975

4" density to maintain 90% of density

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 36 CEILING
ADDRESS _____ DATE 25 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 1 house 17 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE July 1976

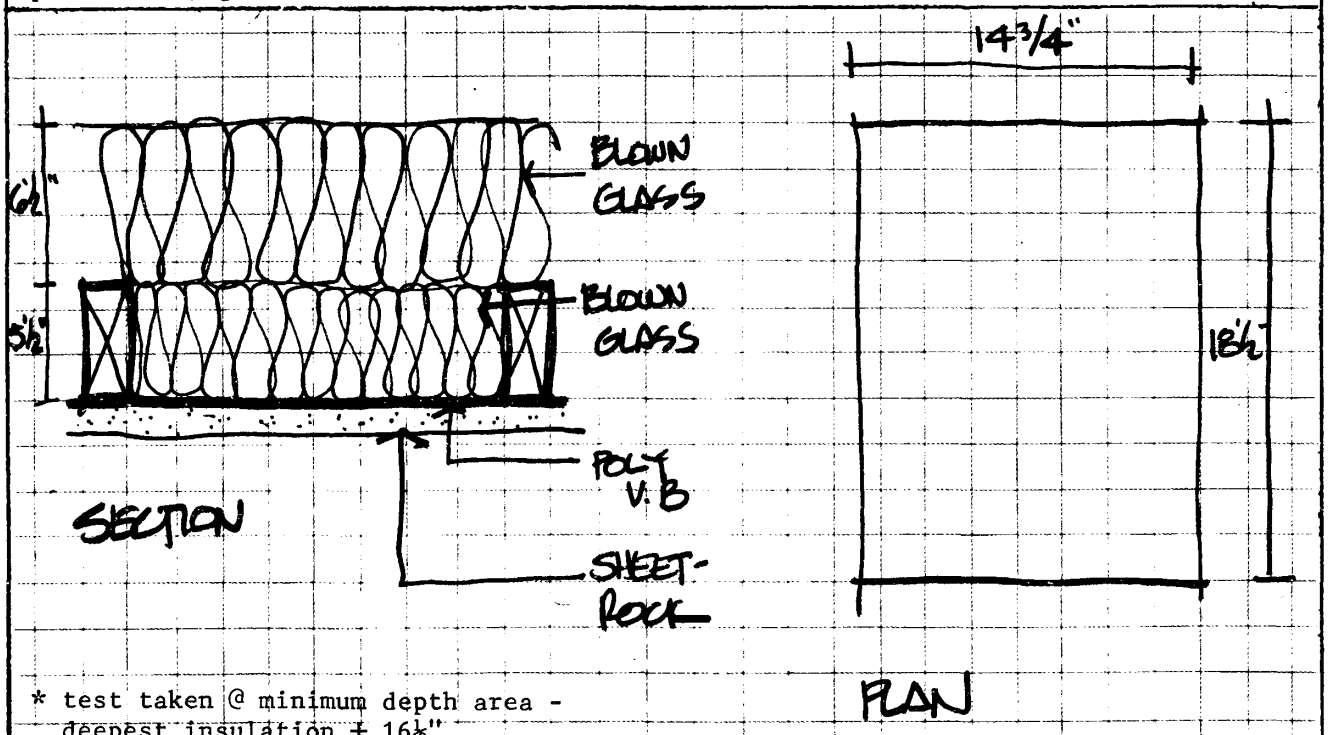
FIELD OBSERVATIONS
plan location(s) bedroom venting N/A
framing type rafter & joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type fiberglass batt vapor barrier type poly
RETROFIT: insulation type fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier N/A

FIELD TESTS
insulation thickness see below* flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



* test taken @ minimum depth area - deepest insulation + 16½"

16½" highspot, average minimum 12"

poly vapor barrier 4 mill then sheet rock

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 37 CEILING
ADDRESS _____ DATE 25 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 16 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 6/75

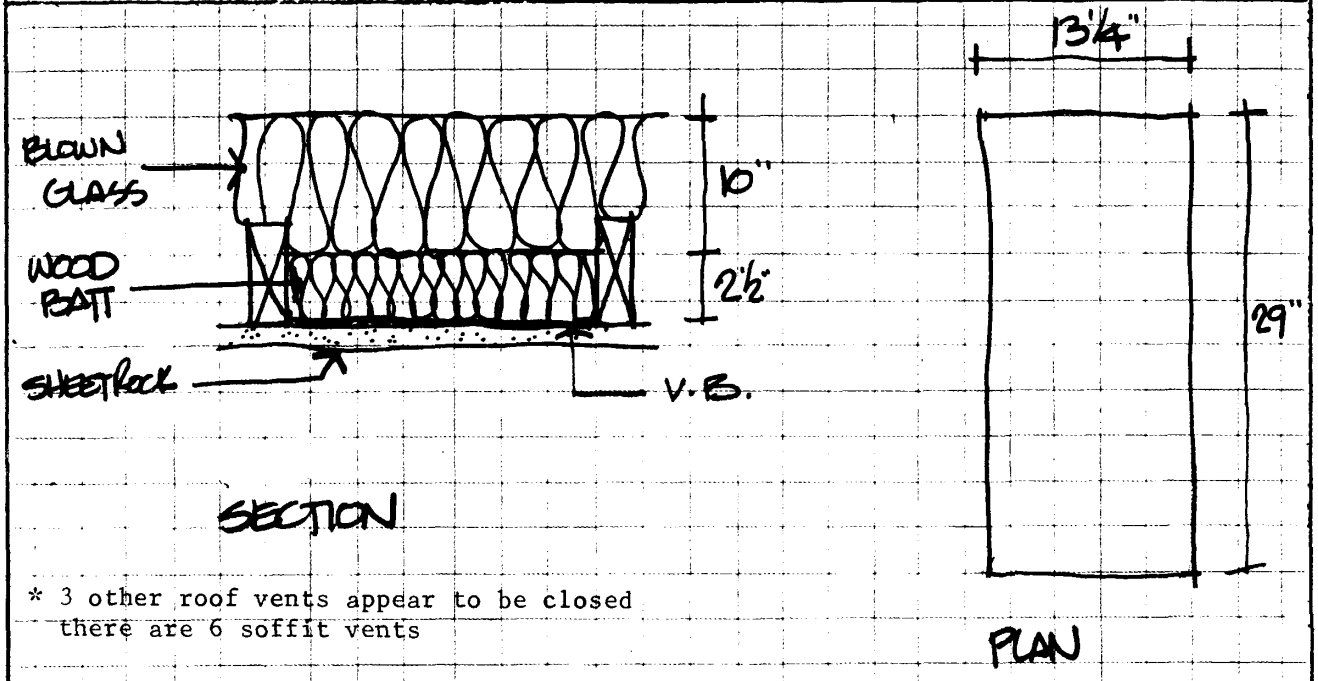
FIELD OBSERVATIONS
plan location(s) hall venting power vent *
framing type rafter & joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type balsam wool vapor barrier type treated paper/ discontin.
RETROFIT: insulation type fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 10" + 2½" batt flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



* 3 other roof vents appear to be closed
there are 6 soffit vents

NOTE: Label reads " 15 bags 988 sq.ft, 6" reblow"

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

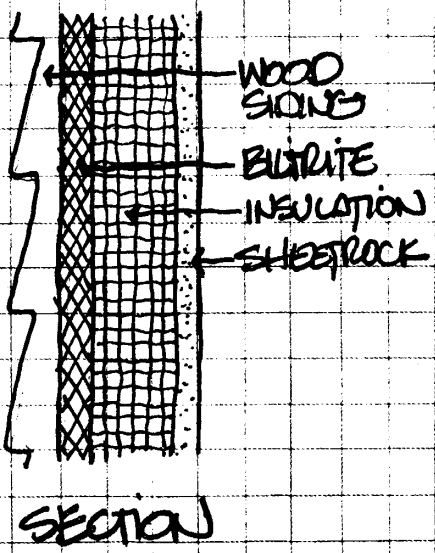
NAME _____ SAMPLE NO. 38 WALL
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 6 mos house 25 ORIENTATION north
HEAT SYSTEM gas F. A. INSTALLER & DATE April '77

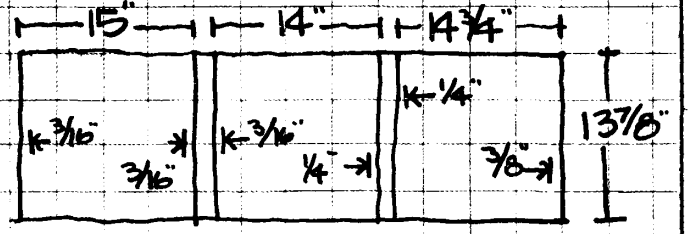
FIELD OBSERVATIONS
plan location(s) living room venting N/A
framing type 2X4 stud condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems none - 2 holes per cavity
difficulty of opening/closing sample boards tight
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability good
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS
insulation thickness 3.5" flame chars, no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



ELEVATION

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 38 CEILING
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

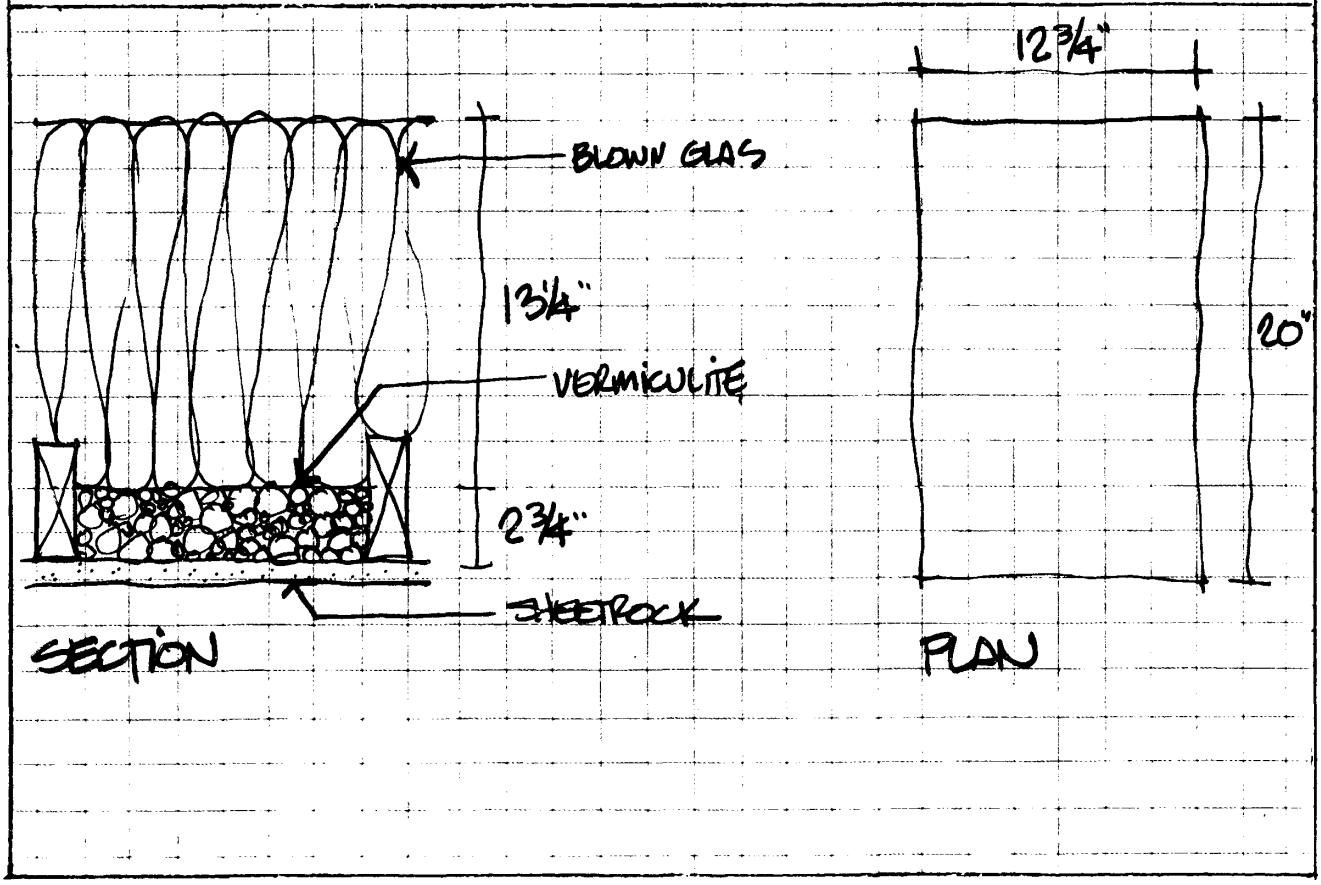
GENERAL
AGE: retrofit 6 mos house 25 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE April '77

FIELD OBSERVATIONS
plan location(s) bedroom venting numerous soffit/5 ridge vents
framing type joist & rafter condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type vermiculite vapor barrier type none
RETROFIT: insulation type fiberglass vapor barrier type none
retrofit installation procedures/problems none - stops to hold soffit vents open
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 39 CEILING
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 18 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE August, 1975

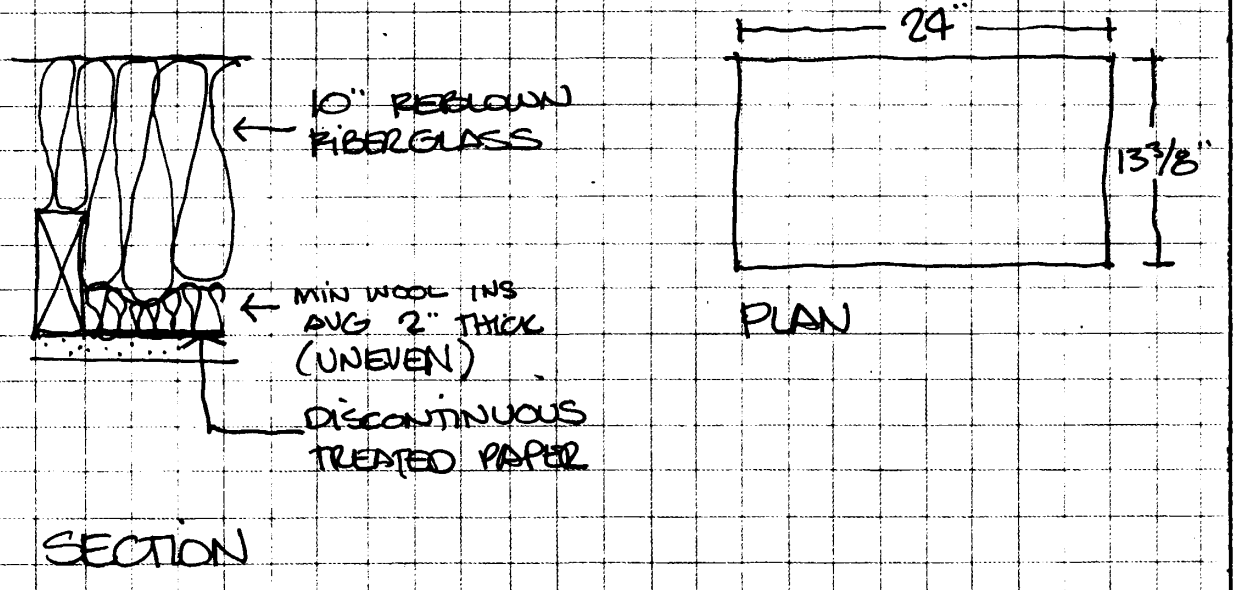
FIELD OBSERVATIONS
plan location(s) bedroom venting 3 roof - 7 louvers-2 ridge
framing type joist & rafter condition of structure O.K.
condition of wiring N/A
ORIGINAL: insulation type mineral wool vapor barrier type discontinuous paper
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



2" original insulation very uneven

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 40 WALL
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL

AGE: retrofit 1.2 house 85 ORIENTATION south
HEAT SYSTEM gas H.W. INSTALLER & DATE July 1976

FIELD OBSERVATIONS

plan location(s) dining room venting N/A
framing type 2X4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems none

difficulty of opening/closing sample none

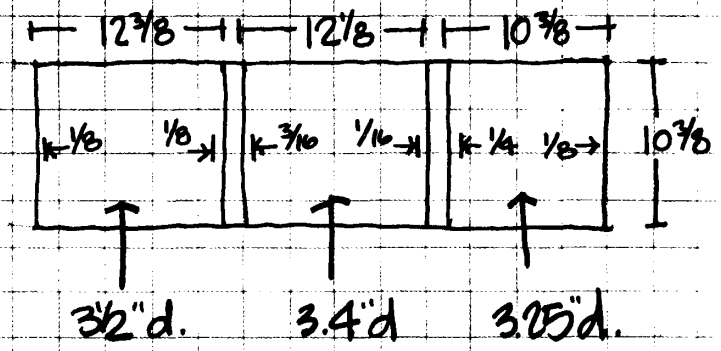
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none

packing N/A friability good
REPLACEMENT: insulation UF vapor barrier none

FIELD TESTS

insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 41 WALL
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD volunteer

GENERAL
AGE: retrofit 6 mos house 69 ORIENTATION east
HEAT SYSTEM gas gravity INSTALLER & DATE February 1977

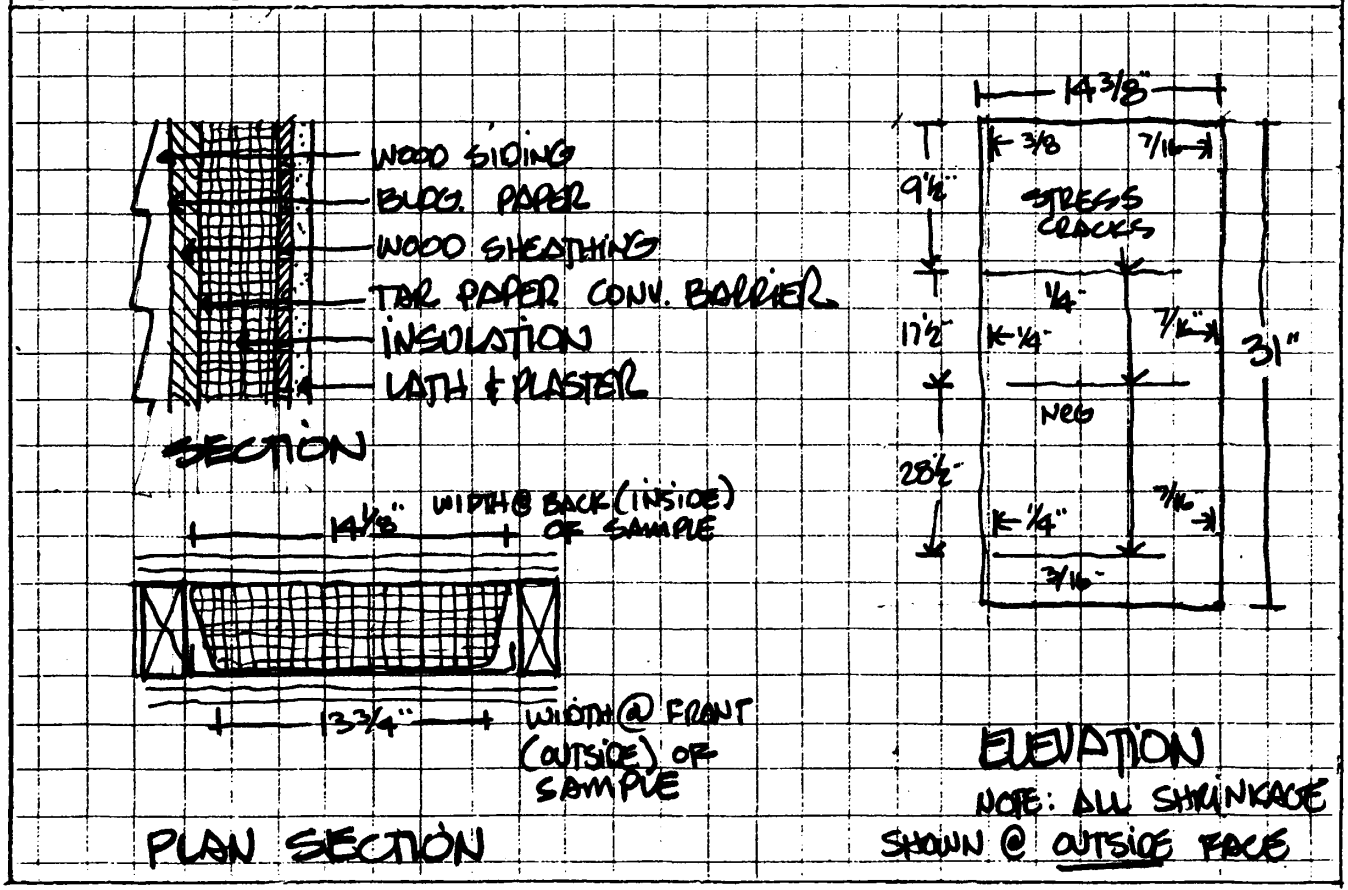
FIELD OBSERVATIONS
plan location(s) bath venting none
framing type 2X4 stud condition of structure good
condition of wiring N/A
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type UF vapor barrier type none
retrofit installation procedures/problems none - single hole @ top of cavity

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing N/A friability good
REPLACEMENT: insulation U.F. vapor barrier none

FIELD TESTS
insulation thickness 3.25" flame char/no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS T

NAME _____ SAMPLE NO. 42 CEILING
ADDRESS _____ DATE 26 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 mos house 12 yrs ORIENTATION N/A
HEAT SYSTEM electric heat pump INSTALLER & DATE June 12, 1974

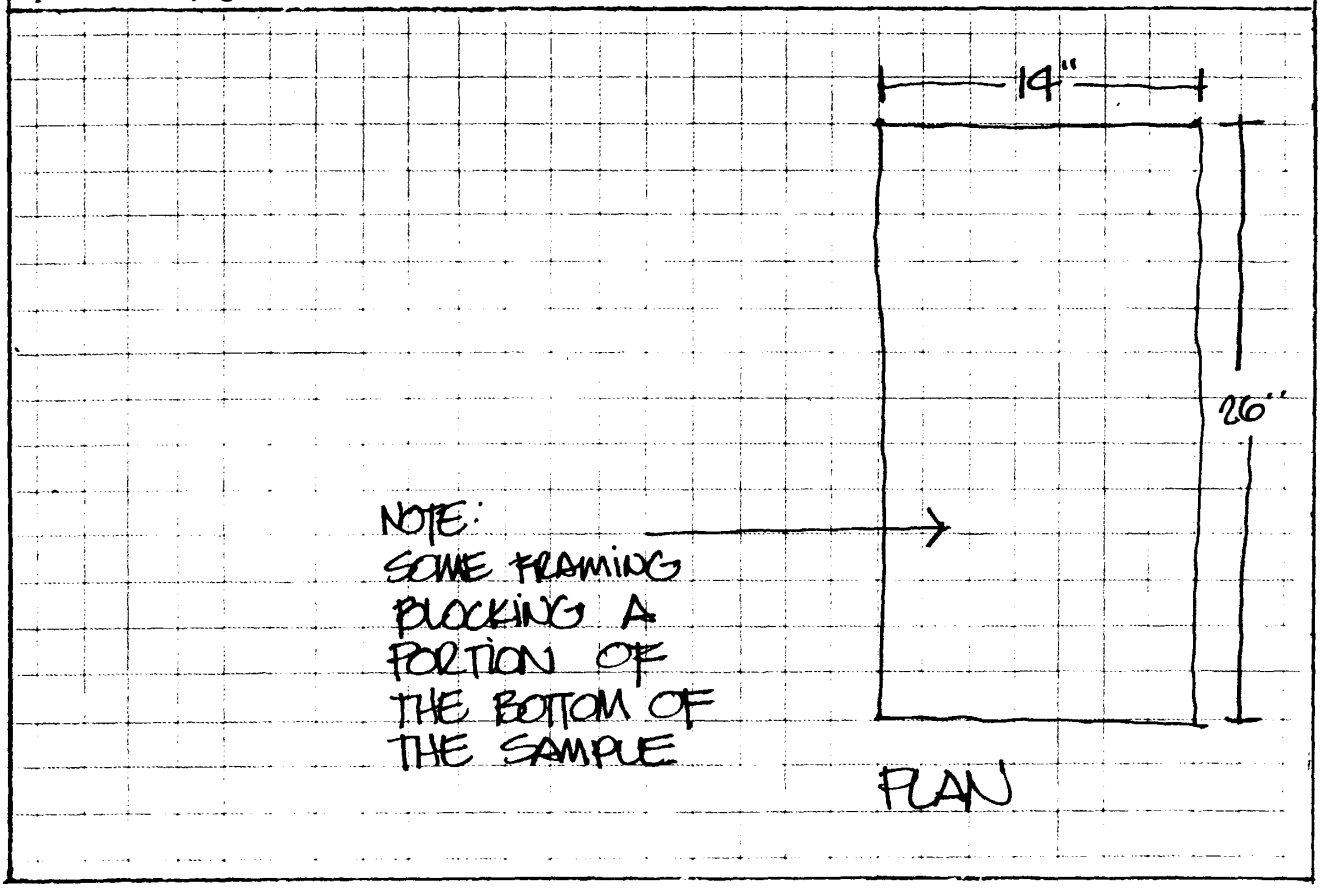
FIELD OBSERVATIONS
plan location(s) bedroom venting continuous soffit & ridge + 1 turbine roof vent
framing type rafter & joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type balsam wool 7½" vapor barrier type poly
RETROFIT: insulation type mineral wool 9" vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness 16½" flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 43 CEILING
ADDRESS _____ DATE 29 August 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 .1 house 14 ORIENTATION N/A
HEAT SYSTEM gas H.W. INSTALLER & DATE July, 1974

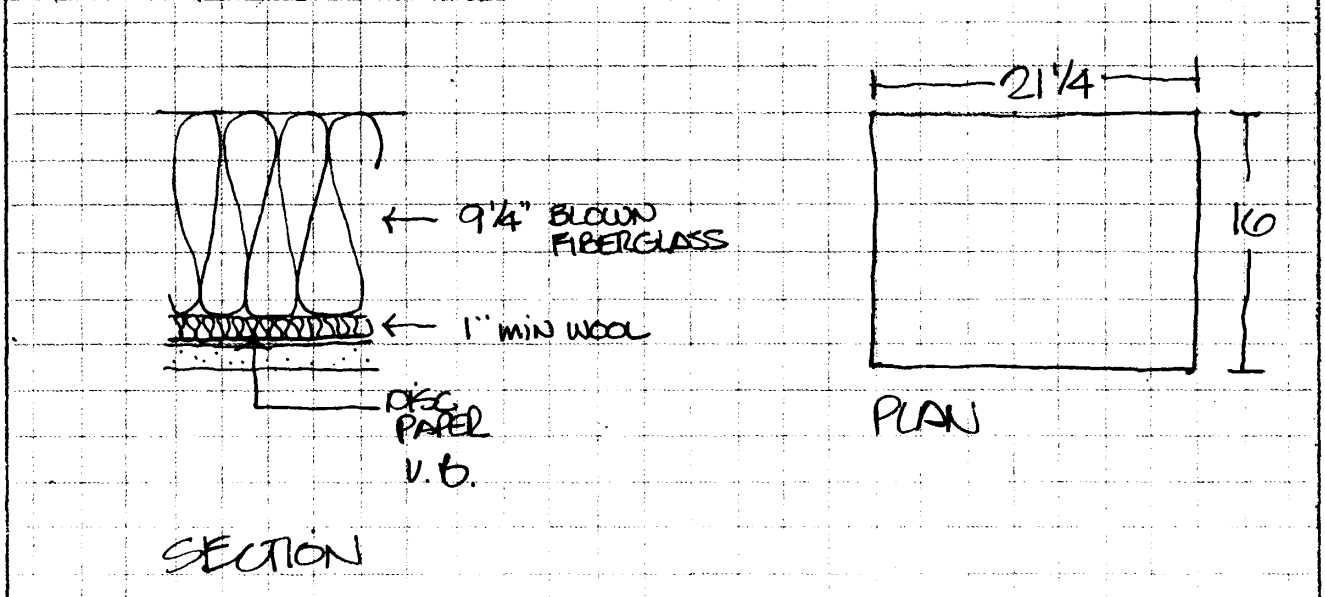
FIELD OBSERVATIONS
plan location(s) bedroom venting 4 soffits, 2 gables*
framing type truss condition of structure good
condition of wiring N/A
ORIGINAL: insulation type mineral wool vapor barrier type paper
RETROFIT: insulation type fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass b. vapor barrier original left intact

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



LABEL: 6" reblow 7/74

* gables 16 X 24

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 44 CEILING
ADDRESS _____ DATE 29 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3,33 house 12-15 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE May 1974

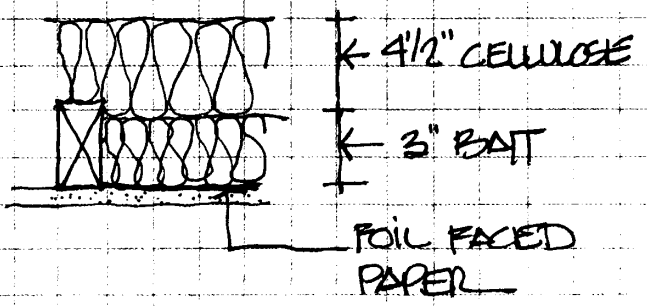
FIELD OBSERVATIONS
plan location(s) bedroom venting 3 ridge, min soffit
framing type rafter & joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type batt vapor barrier type foil
RETROFIT: insulation type cellulose vapor barrier type N/A
retrofit installation procedures/problems none

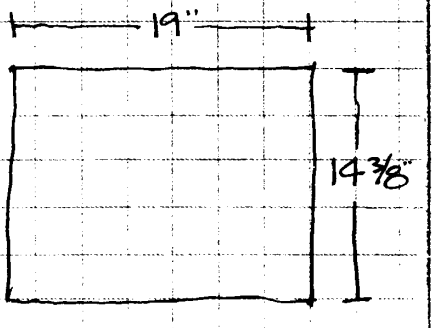
difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness see below flame char / no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)





PLAN

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS(T

NAME _____ SAMPLE NO. 45 CEILING
ADDRESS _____ DATE 29 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3.2 house 22 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 7/16/74

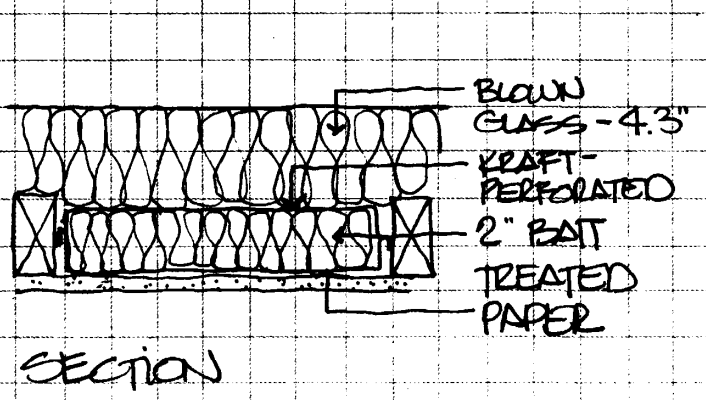
FIELD OBSERVATIONS
plan location(s) bedroom venting minimal
framing type rafter & joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type wool batt vapor barrier type paper
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

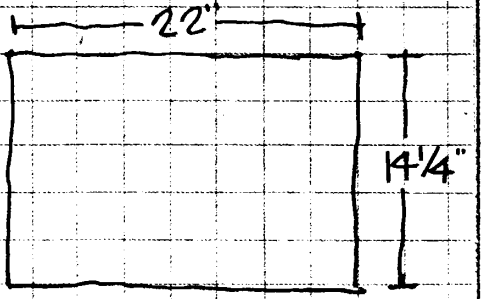
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left in tact

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



SECTION



PLAN

6" Reblown 7/16/74

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME
ADDRESS
PHONE

SAMPLE NO. 46 CEILING
DATE 31 August, 1977
SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2 house 21 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 6/12/75

FIELD OBSERVATIONS
plan location(s) bedroom
framing type rafter/joist
condition of wiring good
venting 2 - 12" dia roof/perf alum soffit v
condition of structure excellent
ORIGINAL: insulation type wood fiber batt vapor barrier type ~~discontinuous paper~~/
RETROFIT: insulation type blown glass vapor barrier type ~~treated~~ N/A
retrofit installation procedures/problems none

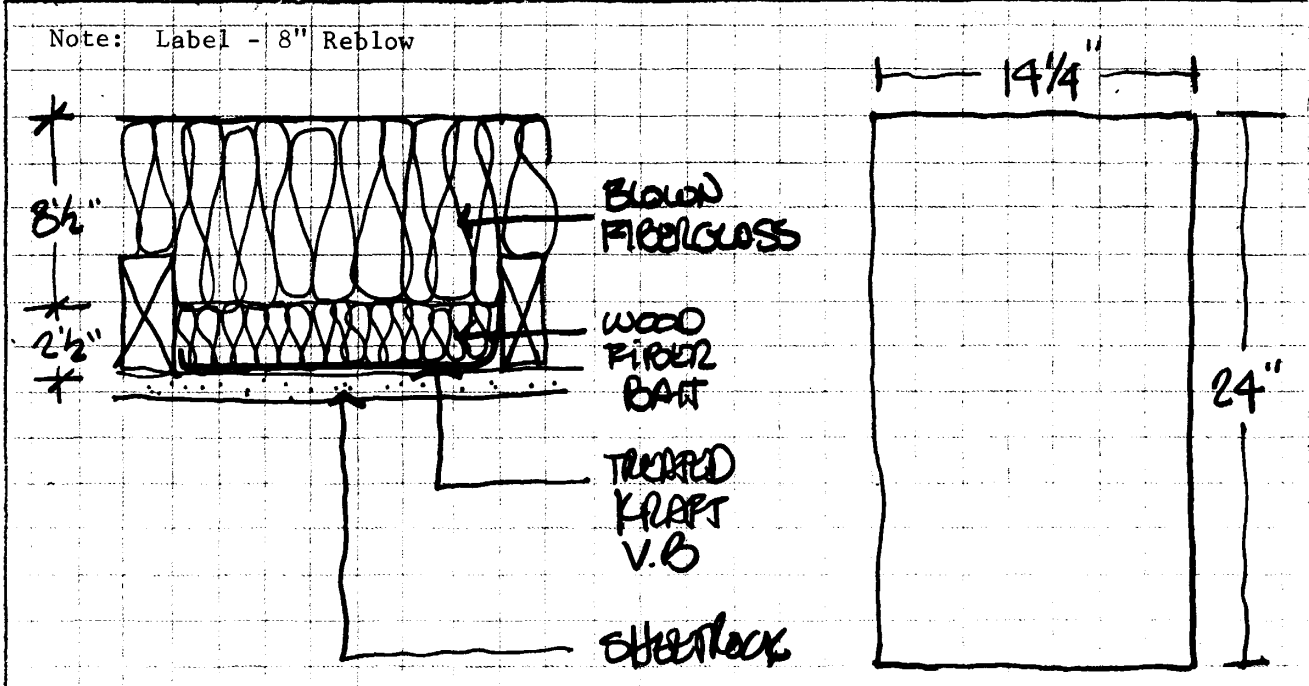
difficulty of opening/closing sample tight closet

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none

packing O.K. friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original in place

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 47 CEILING
ADDRESS _____ DATE 31 August, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 yrs house 23 yrs ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE March 1974

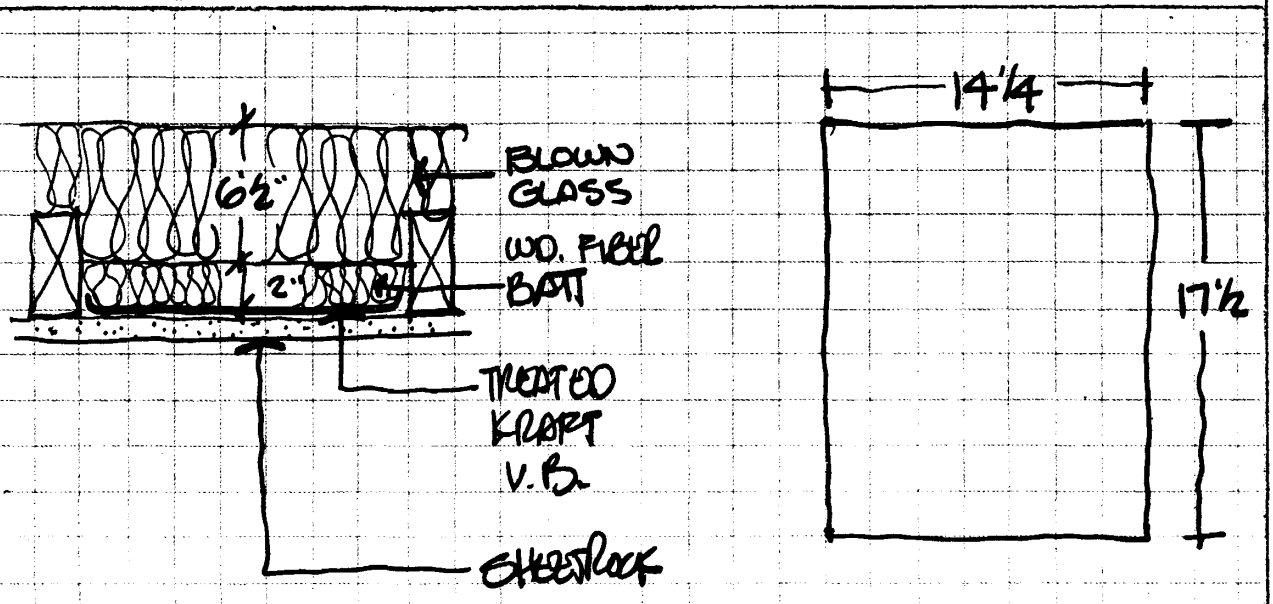
FIELD OBSERVATIONS
plan location(s) hall venting 2 - 6½" dia roof, numerous soffit
framing type rafter/joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type wood fiber batt vapor barrier type treated kraft - disc
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing O.K. friability N/A
REPLACEMENT: insulation batt fiberglass vapor barrier original left in place

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



8½" total thickness (2" wood fiber batt, 6½" blown glass)

NOTE: label read - 6" blown fiberglass

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME
ADDRESS
PHONE

SAMPLE NO. 48 CEILING
DATE 31 August, 1977
SOURCE OF LEAD NSP

GENERAL

AGE: retrofit 3 yrs house 26 yrs ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 8/9/74

FIELD OBSERVATIONS

no soffit vents - owner to install

plan location(s) bedroom venting 2 gable 8X16
framing type rafter/joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type dense wool batt vapor barrier type treated kraft
RETROFIT: insulation type fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none

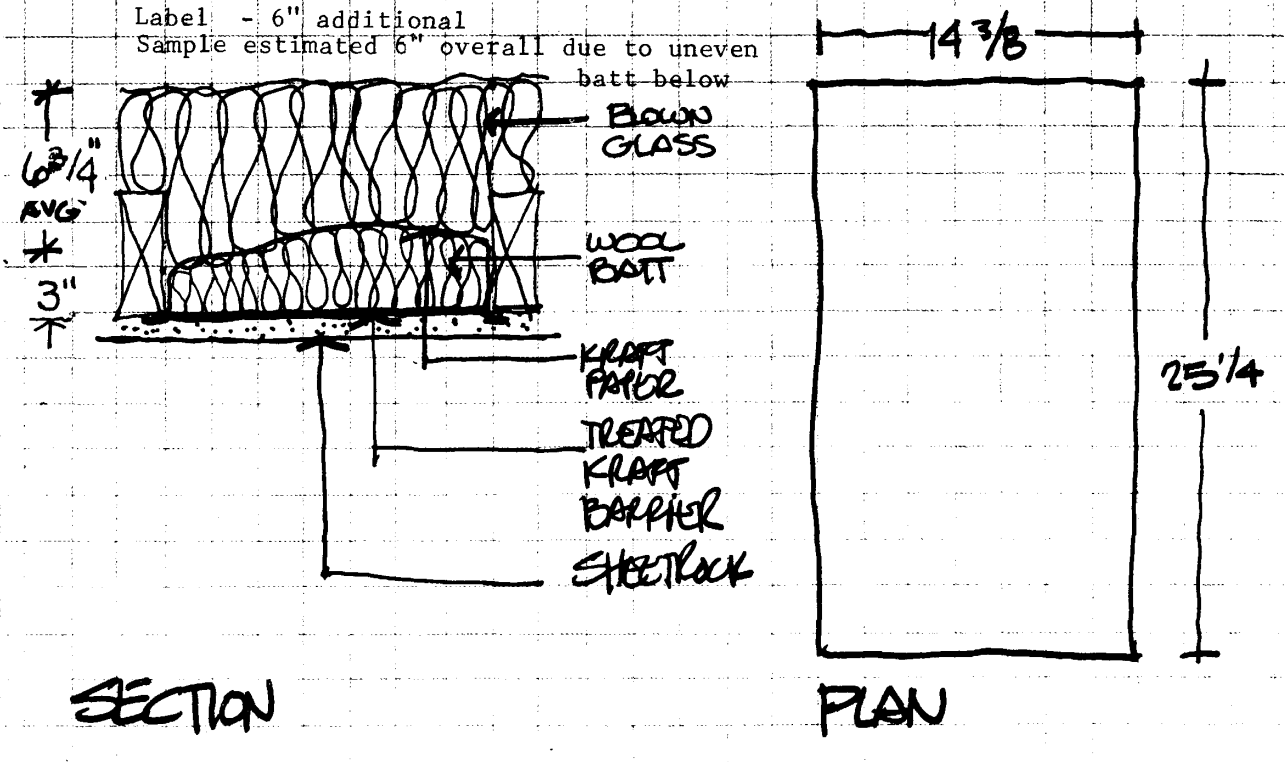
packing O.K. friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original intact

FIELD TESTS

insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)

NOTE: batt - 2 1/4 - 4" depth overall 9 3/4"
Label - 6" additional
Sample estimated 6" overall due to uneven batt below



MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 49 CEILING
ADDRESS _____ DATE 31 August, 1977
PHONE _____ SOURCE OF LEAD Ina Haugen

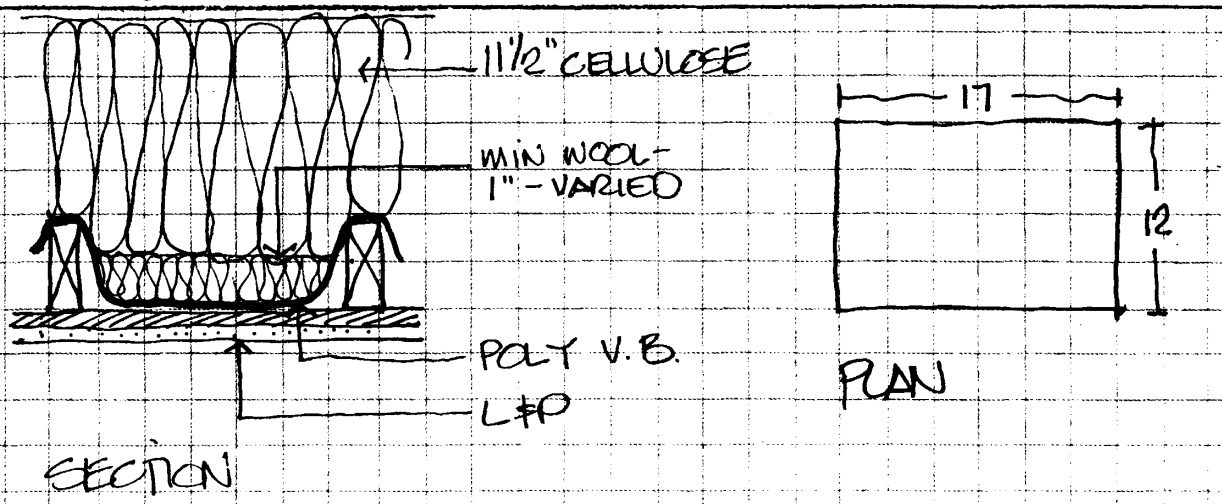
GENERAL
AGE: retrofit 2 mos house 80 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE June 1977

FIELD OBSERVATIONS
plan location(s) bedroom venting 4 - 8" dia roof
framing type rafter/joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type mineral wool vapor barrier type poly (see below)
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems blown-in moderately evenly - very deep
difficulty of opening/closing sample tight access

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier retrofit intact

FIELD TESTS
insulation thickness see below flame Burns

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



* Generally appeared 1-2" mineral wool 10-12" cellulose
Little mineral wool in sample area.
Sample area contained 11½" cellulose.

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 50 CEILING
ADDRESS _____ DATE 1 September,1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 yrs house 12 yrs ORIENTATION N/A
HEAT SYSTEM electric baseboard INSTALLER & DATE June'74

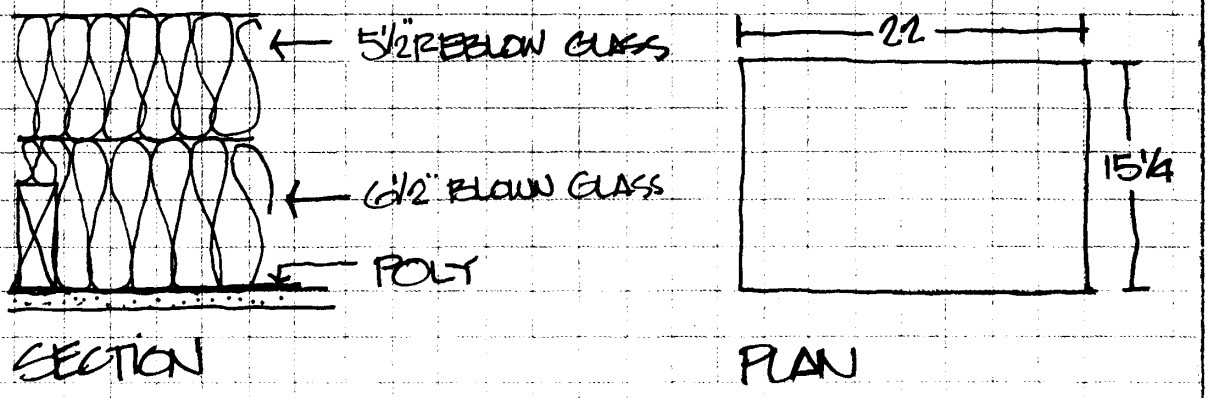
FIELD OBSERVATIONS
plan location(s) bedroom venting prv, ridge, soffits
framing type rafter/joist condition of structure excellent
condition of wiring N/A
ORIGINAL: insulation type blown glass vapor barrier type poly
RETROFIT: insulation type " vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left intact

FIELD TESTS
insulation thickness 12" overall flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



LABELS: 10/8/65
"10" in attic - fiberglass
June 1974 6" blow glass

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

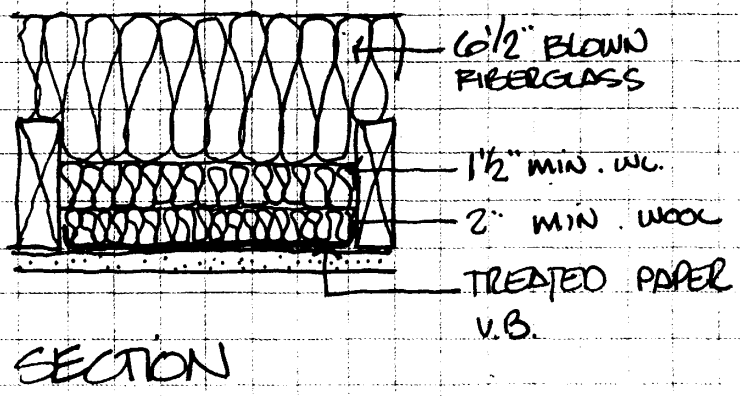
NAME _____ SAMPLE NO. 51 CEILING
ADDRESS _____ DATE 1 September, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 1 house 16 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE May 1976

FIELD OBSERVATIONS
plan location(s) kitchen range vented outside, 2 ridge
framing type rafter/joist venting 5 small soffit
condition of wiring good condition of structure excellent
ORIGINAL: insulation type mineral wool vapor barrier type treated paper
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems none
difficulty of opening/closing sample none
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier original left in place

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



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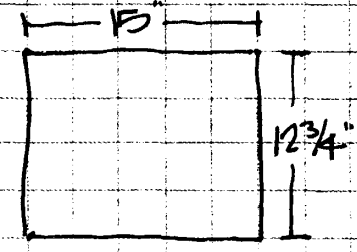


PLAN

NOTE: depth under floor boards 5"

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 52 CEILING
ADDRESS _____ DATE 2 September, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 house 15 yrs ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 8/74

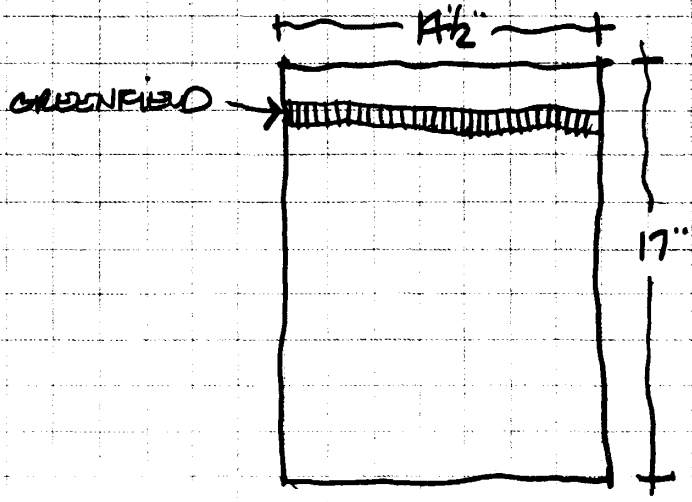
FIELD OBSERVATIONS
plan location(s) bedroom venting 4 soffit, continuous ridge
framing type rafter/joist condition of structure excellent
condition of wiring good
ORIGINAL: insulation type blown glass vapor barrier type treated paper
RETROFIT: insulation type blown glass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier left original in place

FIELD TESTS
insulation thickness 8 3/4" * flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: * average depth over attic 8½ - 9½"
label - 8/1/74 4" reblow

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 53 CEILING
ADDRESS _____ DATE 2 September, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3.25 house 13 yrs ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 6/74

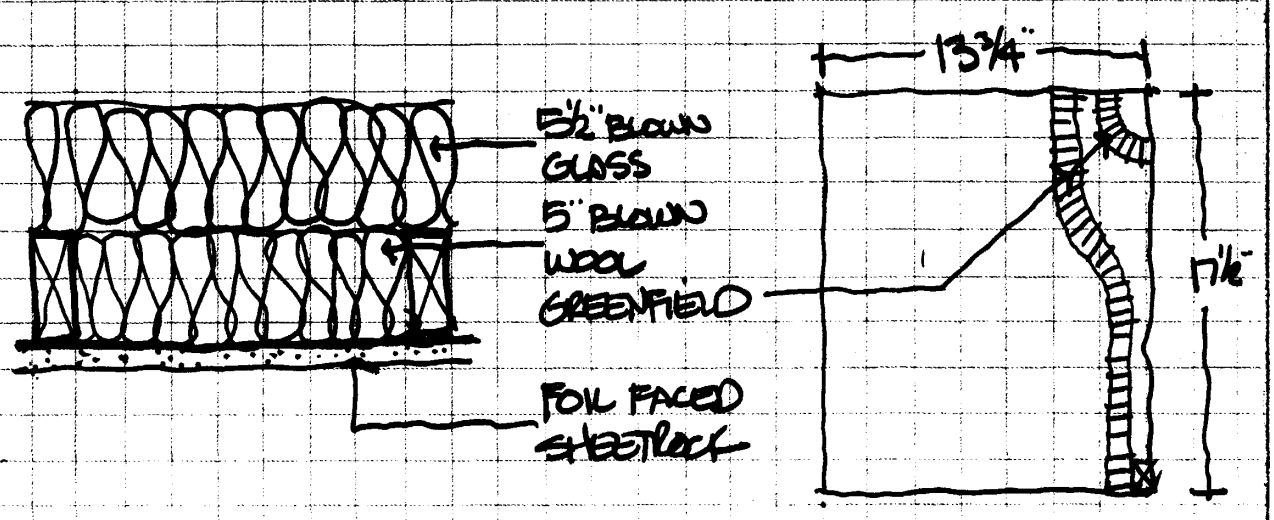
FIELD OBSERVATIONS
plan location(s) closet venting 2 - 10" dia roof - numerous soffit
framing type rafter/joist condition of structure good
condition of wiring good
ORIGINAL: insulation type blown wool vapor barrier type foil faced S.R.
RETROFIT: insulation type blown fiberglass vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample none

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
some water staining on a few roof rafters
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier N/A

FIELD TESTS
insulation thickness see below flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: labels - 8" @ density to maintain 90% thickness 7/27/64

6" reblow 6-74

overall attic thickness varies 10-12"

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

NAME _____ SAMPLE NO. 54 CEILING
ADDRESS _____ DATE 2 September, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 3 house 25 ORIENTATION N/A
HEAT SYSTEM gas F.A. INSTALLER & DATE 8/7/74

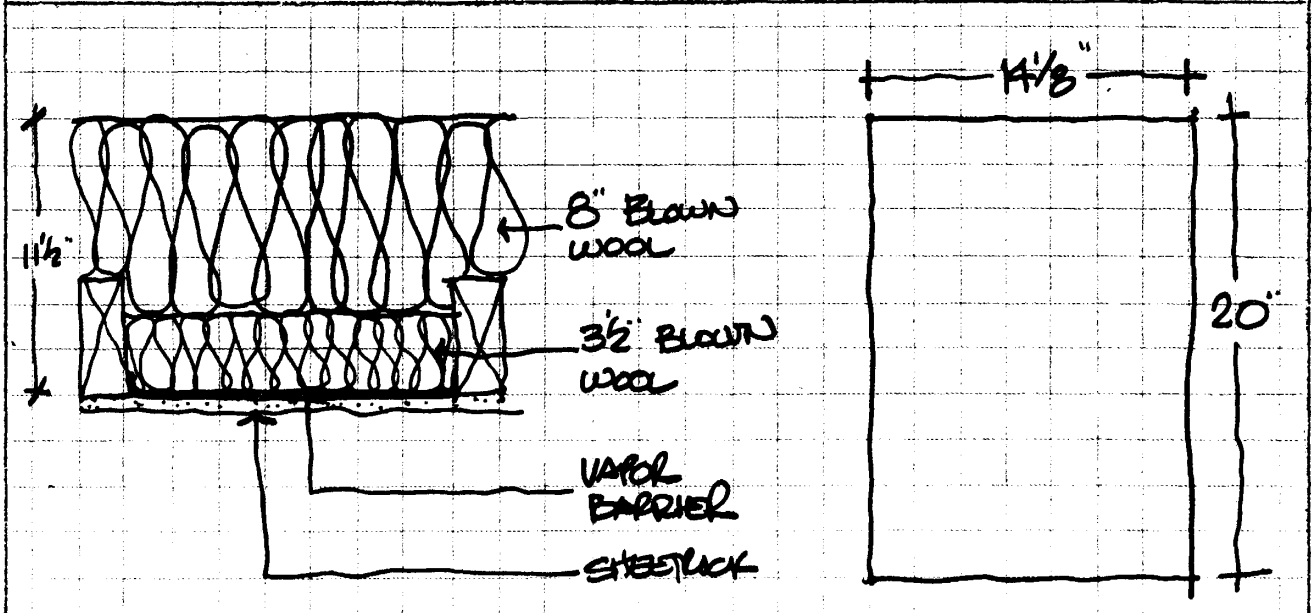
FIELD OBSERVATIONS
plan location(s) hall venting 2 - 10" dia ridge, 4 small soffit
framing type rafter/joist condition of structure good
condition of wiring N/A
ORIGINAL: insulation type blown wool vapor barrier type treated paper
RETROFIT: insulation type blown wool vapor barrier type N/A
retrofit installation procedures/problems none

difficulty of opening/closing sample hot

PRESENCE OF: moisture, corrosion, odor, vermin, fungus
some moisture staining of structure @ roof vent & chimney
packing good friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier N/A

FIELD TESTS
insulation thickness 11 ½" * flame N/A

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



NOTE: label 8/7/74 - 6"

* attic depth average 10-12 "

MINNESOTA ENERGY AGENCY
INSULATION TEST WORKS

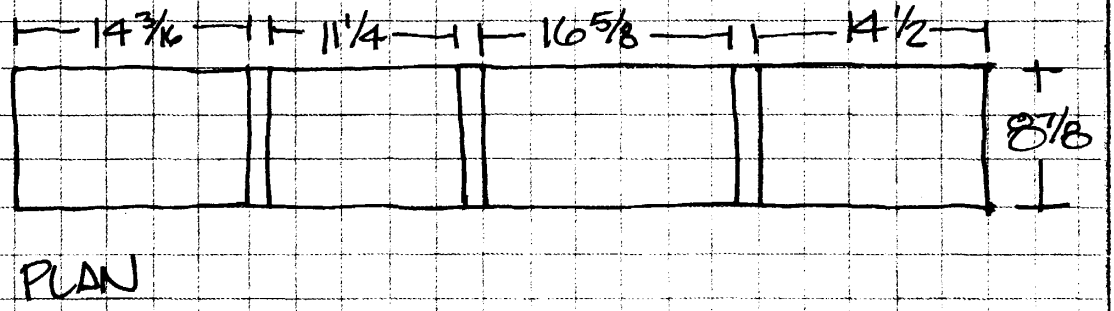
NAME _____ SAMPLE NO. 55 CEILING
ADDRESS _____ DATE 2 September, 1977
PHONE _____ SOURCE OF LEAD NSP

GENERAL
AGE: retrofit 2½ yrs house 45 ORIENTATION N/A
HEAT SYSTEM gas hot water INSTALLER & DATE 4/28/75

FIELD OBSERVATIONS
plan location(s) hall venting 3 - 10" ridge
framing type rafter/joist condition of structure good
condition of wiring good
ORIGINAL: insulation type none vapor barrier type none
RETROFIT: insulation type cellulose vapor barrier type none
retrofit installation procedures/problems floorboards
difficulty of opening/closing sample floorboards/hot
PRESENCE OF: moisture, corrosion, odor, vermin, fungus
none
packing excellent friability N/A
REPLACEMENT: insulation fiberglass batt vapor barrier none

FIELD TESTS
insulation thickness 5 1/4" flame char/no burn

SKETCHES (elevation/plan/section)
(siding, sheathing, building paper, existing insulation, new insulation, insulation thickness(es), vapor barrier(s), ceiling materials, flooring, gables, stops & firebreaks, ventilation, wiring, paint, installation procedures, general notes)



PLAN

NOTE: Contract - R 24
40 bags 1,000 ø